ELECTRICAL REVIEW

and WESTERN ELECTRICIAN with which is consolidated ELECTROCRAFT

VOL. LXII, No. 6. CHICAGO, SATURDAY, FEBRUARY 8, 1913. ISSUED WEEKLY.

ELECTRICAL REVIEW WESTERN ELECTRICIAN ELECTROCRAFT

ELECTRICAL REVIEW PUBLISHING COMPANY
608 SOUTH DEARBORN STREET
CHICAGO

Charles W. Price, President and Treasurer.
A. A. Gray, General Manager. H. S. Tuthill, Secretary.
J. B. McCarthy, Asst. Gen. Mgr. C. W. Forbrich, Asst. Treas.

E. E. Wood . . . . . 13 Park Row, New York, N. Y.
Manager Eastern States.
J. B. McCarthy . . . . . Buhl Block, Detroit, Mich.
Manager Middle States.
C. W. Forbrich . . . . . Chicago, Ill.
Manager Western States.

ELECTRICAL REVIEW AND WESTERN ELECTRICIAN

Charles W. Price.....Editor-in-Chief
A. A. Gray.....Managing Editor
Morton Githens Lloyd.....Technical Editor
F. H. Bernhard.....Associate Editor
Howard Ehrlich .....Associate Editor
J. E. Latta.....Associate Editor

SUBSCRIPTIONS.

One Year, United States.....$3.00
One Year, Canada..... 4.00
One Year, Foreign Countries..... 6.00
Single Copy, 10 cents. Back numbers, beyond one month, each .25

Entered as second-class matter, November 7, 1908, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

CONTENTS.

EDITORIAL:
Lamp Rating and Lamp Selection.....285
The Steam Gas Turbine.....286
Flat-Rate Lighting Analyses.....287
New Chairman Named for Public Service Commission of New York.....287

DEPARTMENTS:
Commercial Practice 295
Electrical Construction 298
Dollar Wiring Kinks.....304
Among the Supply Men.....305
Public Service Commissions 306
Questions and Answers 308
New Electrical and Mechanical Appliances 318
Current Electrical News.....325
Record of Electrical Patents.....331

LEADING ARTICLES:
Analysis of Central-Station Conditions in a Small Town..291
The Use of a Large Lighting Battery in Connection with Central-Station Supply.—By F. H. Whysall.....295
Circuits for Elevator Signalling.—II.....298
The Present Status of Grounded Secondaries.—By W. J. Canada 299
Convention of Western Association of Electrical Inspectors.310
Prime Movers.—By S. Z. de Ferranti.....314

BOOK REVIEWS.....317

MISCELLANEOUS:
Boston Motor Club Meets.....288
Electricity in the Signal Corps.....288
Illumination for the Inauguration.....288
E. E. McCall.....289
Connecticut River Power Project.....290
Association of Engineering Schools Formed.....290
To Extend Telefunken System of Wireless Telegraphy....290
Chicago Jovian Lunch Club Formed.....290
Electricity in Construction Work.....297
For Grimy Hands.—By C. W. Goddard.....301
State Licenses for Electricians Proposed in California.....302
Change in Management of Central Electric Company of Peoria 302
Among the Contractors 302
Suggestion for Changing Heights of Meters.—By A. E. Anderson 303
Guy Carlton 303
New Orleans Electric Appliance Company has Big Evening 305
Marconi Company Seeks Cancellation of Contract with English Government.....308
Banquet of Patent Law Association.....309
Philadelphia Section Activities.....316
Electric Vehicles and Accessories at Chicago Automobile Show 317

Copyright, 1913, by the Electrical Review Publishing Company.

LAMP RATING AND LAMP SELECTION.

The voltage (or wattage) at which an incandescent lamp should be operated is determined by so balancing the costs of operation and of renewals as to make the total expense a minimum. The life of a lamp varies inversely with the temperature and so does the specific consumption (watts per candle). It is advantageous to lengthen the life and to decrease the specific consumption, since the former decreases the cost of renewals and the latter decreases the cost of power for a given illumination. A proper balancing of these two elements hence determines the temperature, and thus the best voltage and wattage for operation. Since the cost of energy is not always and everywhere the same, the best condition of operation for a given lamp is not everywhere the same and the rating of a manufacturer can only apply to some definite conditions of use. In order to take this feature of the case into consideration, certain manufacturers give an incandescent lamp a triple voltage rating, and the highest of the three ratings is the proper voltage for operation with the generally prevailing prices at which electrical energy is sold for lighting purposes by central-station companies.

In selecting a lamp for use upon the lighting circuit of a central-station company it is, consequently, to the advantage of the customer, where he pays for renewals, to have a lamp which is rated at the voltage at which his circuit is actually operated. When, however, the line voltage is not constant, consideration must be given to the effect which voltage fluctuations will have upon the conditions which are considered in the rating of the lamp. Since the effect upon life of an increase or a decrease of voltage from the normal is not the same, it does not follow that the average voltage of the circuit will be the best for the rating of the lamp which is to be used upon it. However, it has been shown that unless these fluctuations exceed six per cent, the proper voltage for the lamp will not differ from the average voltage by as much as one volt upon a 110-volt circuit. Consequently, with the regulation which is customary upon the lighting circuits of central stations, it is advantageous to use a lamp which has a top rating equal to the average voltage of the line.

Many central-station managers have evidently not appreciated this fact, and from a fear of inordinate burn-outs have supplied their customers with lamps which are rated at a higher voltage than the average value existing upon their circuits. This is

a mistake for which there is little excuse. It is disadvantageous for the customer, inasmuch as he does not get all the light to which he is entitled for the power which he is consuming, since the candlepower of a lamp falls off much more rapidly than the power, when the voltage is lowered. The central station is itself also a loser, from the fact that a low voltage means also a low wattage, and the consumer is not using as much energy as would be consumed if the lamp were properly suited to the circuit. This is, consequently, an ill wind which blows nobody any good.

Where the question of variation of voltage with distance from the power house is concerned, the above considerations do not apply. But here, again, if the variation is small the best net result will be obtained if the lamp is suited to the mean voltage, providing lamps of only one rating are available. In this case it is possible that customers near the power house will be troubled with too frequent burnouts, due to the short life resulting from operation at too high voltage. If, however, free renewals are provided by the operating company, this burden would come upon the company itself and would be compensated by the conditions which obtain with the outlying customers. If the range of voltage amounts to several volts it would be preferable to carry in stock lamps of more than one voltage, and see that customers in different parts of the territory receive the lamps best suited to the local value of the voltage.

To summarize, there is a very general condition of using lamps which are rated too high for the circuit. Every central-station manager should see to it that he is supplying the best lamp for his customers' circuits.

THE STEAM GAS TURBINE.

Dr. Sebastian Z. de Ferranti, who for the past quarter of a century has been one of the most original workers in certain branches of electrical design and invention in England, in delivering the James Watt anniversary lecture at Greenock, Scotland, on January 16, made a statement which was little short of sensational. With "Prime Movers" as the text for his discourse, he gave, we believe for the first time in public, an account of certain remarkable work upon which he has been engaged for some time past in connection with the steam gas turbine. Before doing so, however, he mentioned the press reports of "all the wonderful successes of large oil engines in Germany and elsewhere," adding the assurance that few people had any conception of the failures and breakdowns which had occurred and were repeatedly occurring, with the big experimental engines that had been constructed. "In Germany, especially, where so much has been done in this direction, they carefully avoid informing the foreigner on these points."

The subject of prime movers is one that has always been of paramount interest to Dr. Ferranti, and remembering the exceptional nature of his pioneer work on the Deptford high-tension scheme, and his original conceptions in other directions, one is justified in expecting something of real interest and importance to emerge from his brain in respect to turbines. His constant aim—in recent years one might almost have called it a campaign—has been to increase the amount of work that can be usefully obtained from a given amount of fuel. It is well known that the higher the temperature of the working fluid, the higher is the efficiency that can be obtained. Higher temperatures have, however, proved very difficult to work with—for example, note the low working temperatures of turbines for marine propulsion. Several years ago, seeing that the difficulties were mechanical and that great advantage could be derived if these troubles were overcome, Dr. Ferranti commenced experimenting and now, after many failures, and the expenditure of much money and time, he claims to have produced a turbine which at the highest temperatures and with great and rapid variations of temperature, is quite free from mechanical troubles. He believes this turbine to be perhaps the strongest from a mechanical point of view that has yet been produced, and contrary to what might have been expected with a high-temperature machine, "it runs with certainty with a blade-end clearance that is so small that it is almost negligible from the point of view of leakage loss, and the fear of possibility of stripping appears to have been effectively removed."

In the Ferranti turbine the steam is initially superheated, and after the first expansion, and while it is still superheated, it is resuperheated before it does its work in the second stage of the turbine. After this, it is exhausted in a superheated condition through a regenerator to the condenser. The whole of the blading is electrically welded, so as to avoid the straining due to calking at the high temperatures that are reached, and also the loosening that occurs due to the same cause. The blading is formed of mild steel with a thin coating of nickel. It is most accurately finished to shape by a process of step-by-step pressing under very heavy pressure. Although the turbine is of the reaction type, no balance dummy is used. The whole of the end load is taken on a specially constructed thrust bearing, thus saving steam leakage. The steam is worked as a gas at high temperature throughout the turbine, and this, coupled with the many mechanical improvements has, it is said, given very good results. It appears that the 5,000-horsepower machine which has now been running for some time, when tested at a load of two-thirds full power, has given a brake horsepower-hour on 7 pounds of steam, which, if supplied by an oil-fired boiler superheater system of 85-per-cent efficiency would consume less than 0.625 pounds of oil per horsepower-hour. The results of many tests show that when this turbine is run at full load under favorable conditions it will take less than 6 pounds of steam per brake horsepower-hour, and that the system under the conditions named will have a thermal efficiency of over 24 per cent.

FLAT-RATE-LIGHTING ANALYSES.

The introduction of flat-rate incandescent lighting into residences and commercial houses involves many considerations of interest to the central-station manager. Opinions may differ as to the desirability of such service, but there is no doubt it is to be reckoned with in considering the various methods of popularizing the use of electricity in the home and office. It has attained a pretty healthy growth within the past three or four years, and has been discussed in the technical press from a good many points of view. One aspect of flat-rate lighting, however, has received insufficient consideration in some circles, and that is the analysis of the results secured from its use in certain cities and towns where it has become an important feature of the business.

A common charge for such service is one cent per watt per month, the user having the privilege of employing a stated connected load freely during this period, provided he does not exceed the number of outlets specified in his contract, which is usually much below the total number for which the establishment is wired. The success of this charge in many installations has led to its adoption elsewhere, and in the press of new business a good many operating companies have failed to determine just what its effect has been upon their own systems. Doubtless in other cases exhaustive studies have been made of the working of the flat rate in practice, but the following example illustrates the need of paying more attention to the matter.

In a representative case where the flat-rate lighting forms a small proportion of the total, the company assumed that the energy sold in this way brought in an income of 10 cents per kilowatt-hour. The total funds received from this class of customers in cents divided by 10 was taken as the total energy absorbed on the flat-rate loads. In determining the line losses as a whole the company took the difference between this estimated consumption plus that of the metered consumers and the total readings of the meters on the feeders at the station, in order to get an idea of these losses. This practice was subjected to considerable questioning at a hearing before a state commission in which flat rates were incidentally discussed, and it needed little skill to show that the method, while not subjecting the company to great error, lacked precision and rendered its system of charges rather empirical.

Wherever a company introduces flat-rate lighting it is a comparatively simple matter to install a few meters on each class of service covered, and thus obtain a desirable check on the energy consumption of the different installations. In this way the energy taken can be determined for different seasons of the year, month by month, and the actual rate yielded per kilowatt-hour determined for future reference. Records of this kind are valuable in comparing the earnings of various classes of service, testing the fairness of the flat rate under stated conditions, and contrasting the performance of measured feeders with sections of the distribution system supplying only flat-rate customers. The actual rate received on the basis of a charge of one cent per watt per month varies according to the use made of the contracted load, and may range from 8 or 10 cents, or even more, to less than 2 cents in cases where the lamps are turned on and left burning for excessive periods. Even if the services are protected by automatic devices which keep the demand down to a stated maximum, the central-station company can well afford to find out what its flat-rate consumers are doing with their connected loads, and the simplicity and low cost of doing this with a few well placed meters should not escape the attention of the manager who desires to really know the operations of his plant.

NEW CHAIRMAN NAMED FOR PUBLIC SERVICE COMMISSION OF NEW YORK.

For some time the attention of all interested in the development of public utilities and in the fortunes of the Public Service Commission of the State of New York, has been focused upon the appointment of a successor to Mr. William R. Willcox as chairman of the First District Commission. One of the earliest bodies created for its particular functions, the Public Service Commission of the State of New York, by reason of the big questions involved and the magnitude of the interests subject to its regulation and control, has been watched most carefully by economists, financiers and engineers the world over.

The chairmanship of the Public Service Commission for the First District of the State of New York is an important post. Mr. Willcox has fulfilled his arduous duties in an exemplary fashion and when in the event of political exigency it became expedient to replace him, it is a matter for further congratulation that Governor William Sulzer has been able to prevail upon Judge Edward E. McCall to accept this appointment. Mr. McCall was nominated by Governor Sulzer on February 3, and his nomination was immediately confirmed by the State Senate.

The transportation problems of Manhattan, the Bronx and Brooklyn have engaged the serious attention of men of great intellect and financial power, as well as those of great engineering ability, for some time. There is opportunity for Judge McCall to bring to bear his great talents in not only a judicial but practicable working out of this terrific transportation proposition. His record of achievement and the universal esteem in which he is held in the city would seem to assure the co-operation of everyone interested in the problems which will come under his official observation. Now that so excellent an appointment has been made it is sincerely hoped that corporations and citizens alike will hold up the hands of the governor and his commissioner in facilitating early consummation of those things that are most desirable in the relation of the public service corporations and the public which they serve.

Boston Motor Club Meets.

Nearly 100 members of the Massachusetts Electric Motor Car Club, of Boston, Mass., attended the meeting and dinner on January 28 at the Georgian, and afterward went in a body to see an exhibition of moving pictures of electrically propelled fire apparatus and electric vehicles at the Bijou Dream Theater.

At the dinner a model of an electric pleasure car, done in ice, adorned the head of the table in front of President Day Baker.

Mr. Baker quoted the testimony of a large brewer, who stated in a published article in the New York *Journal of Commerce* that of 112 electric machines now in use by him only two were ever in the repair shop at once, while often 25 per cent of his gasoline machines were laid up for repairs. He also referred to a bill now pending before the legislature of Massachusetts which limits the weight of automobiles to 800 pounds to each inch in width of tire. The increase in the price of gasoline is to be used in connection with advertising electric trucks and pleasure cars in the local newspapers.

The club then adjourned to the theater, where views were seen of motor-driven fire apparatus in use in Springfield, Mass. Another film showed the Electric Vehicle Club's parade in Boston last Memorial Day, when 115 cars were in line and paraded through the streets of the city. A quotation from Thomas A. Edison was thrown on the screen, which read: "Fifteen years from now more electricity will be sold for electric vehicles than for light."

A number of the members brought with them fire-department officials of cities and towns around Boston. The arrangements for the exhibition at the theater were made under the auspices of the New England Section of the Electric Vehicle Association of America.

Electricity in the Signal Corps.

The members of the Colorado Electric Club, at their regular weekly luncheon on January 23, heard Edward A. Smith, captain of the Signal Corps of the National Guard of Colorado, talk on "The Signal Corps, Its Organization, Electrical Equipment and Duties." He explained the erection of the field telegraph and telephone equipment and its operation in war times. Captain Smith has been a member of the National Guard for six years and is also active in Electric Club affairs. An invitation was extended to the members to visit the armory of the National Guard, where an actual demonstration of the electrical equipment of the state guards will be shown.

Announcement was made that John M. Mulvihill, chairman of the Entertainment Committee, was planning a smoker to be held some time in the near future.

On January 30, George G. Anderson spoke on the "Future Extension of Irrigation by Pumping." Mr. Anderson is a consulting engineer of wide experience in irrigation matters and he contended that the future development of irrigation in Colorado depended to a great extent on the electric pump.

Illumination for the Inauguration.

Washington is in the midst of preparations for the inauguration of President-elect Wilson on March 4, and it is expected that the decorative illumination of the city will be more effective this year than it has ever been before.

There will be many features of novelty in a Court of Honor, which is to be erected in front of the White House, and which will contain the President's reviewing stand.

The illuminations of Pennsylvania Avenue from the Treasury to the Peace Monument will be elaborate and will consist of festoons of lights across the street by means of loops supported at three points on steel messengers. From the center of the span there will be dropped a brilliantly illuminated pendant in varied colored lights. These festoons will be spaced at intervals of 100 feet.

The treatment of the Peace Monument, at the lower end of the Avenue facing the Capitol, will be the same as formerly. The fountain will be in operation and will be brightly lighted from three spot lights placed near the base. These spot lights will be provided with color screens so that combinations of color can be effectively used upon the flowing water.

The dome of the Capitol will be also brilliantly illuminated by large search lamps placed on the west roof of the building and on the roofs of the House and Senate office buildings, so that the dome will be illuminated from all sides.

The illumination of the Washington Monument will be by search lights and spot lights, the latter being placed in the Monument lot with their rays directed towards the lower portion of the monument, while the search lamps from the roof of the Raleigh Hotel, from the War, Navy and State Department Building and from the roof of the Potomac Electric Power Company will be directed to the north and east sides of the Monument.

The committee plans to decorate this year a portion of the Union Station Plaza in connection with the work of street decoration done by the Committee on Street Decoration. This plan is not a particularly elaborate one but is very effective. The flag poles located back of the Columbus Memorial will be brilliantly spiralled with electric lights and spot lights will be used to bring out the beauties of the Memorial. It is probable also that the cedar trees which will be used to outline the outer circle of the Plaza will be effectively decorated either in the manner of a Christmas tree or with festoons of lights suspended immediately over them from poles conveniently placed.

In all of this festoon work the lamps will be mainly of four candlepower, with clear globes.

It is planned that the Court of Honor shall be brilliantly illuminated and a distinction is made between illumination and decoration. The architect's conception of the Court of Honor is very artistic. The President's reviewing stand erected on the south side of Pennsylvania Avenue immediately in front of the White House is a reproduction of the classic part of the Judson Mansion at Monticello. On either side of this porch is the stand designed for the seating of distinguished guests of the Nation, this being a small but classic design, columns carrying a light railing, a duplicate of the railing surrounding the portico at Mount Vernon and decorated over the tops of the columns with small cedar trees. On either wing of this stand there is a heavily massed hedge of cedar trees 30 feet high extending for over 200 feet east and west of the reviewing stand running parallel to the street, the ends being closed with cedar trees brought up to the curb line where the hedge ends in a beautiful specimen of cedar tree 60 feet high. The north side of the Court of Honor is one continuous reviewing stand, the end being closed with cedars over the sidewalk and to the curb line in the same manner as on the south side. This gives a long rectangular court of the utmost simplicity and yet very beautiful.

The porch in which the President sits is to be brilliantly lighted with spot lights thrown from the north stand, it being designed to bring out this feature of the stand in bold relief. No lamps are to be on the stand, but the hedges of cedar trees at either end are to be brilliantly illuminated with color boxes located on the curb line behind a five-foot balustrade erected at that point. These color boxes contain arc lamps of large candlepower using gelatine screens in front, it being the purpose to throw on this hedge a dense blue and gold in sharp contrast with the green foliage. At the outside ends of the Court of Honor there will be a classic group of statuary placed in a recess formed by the trees extending to the curb line and the back of this group will be illuminated from concealed incandescent lamps placed in the foliage, while the front will be brought out sharply by means of spot lights. An artistic feature of this scheme is the contemplated placing of myriads of small lamps in the hedge itself, some 1,200 or 1,500 being used.

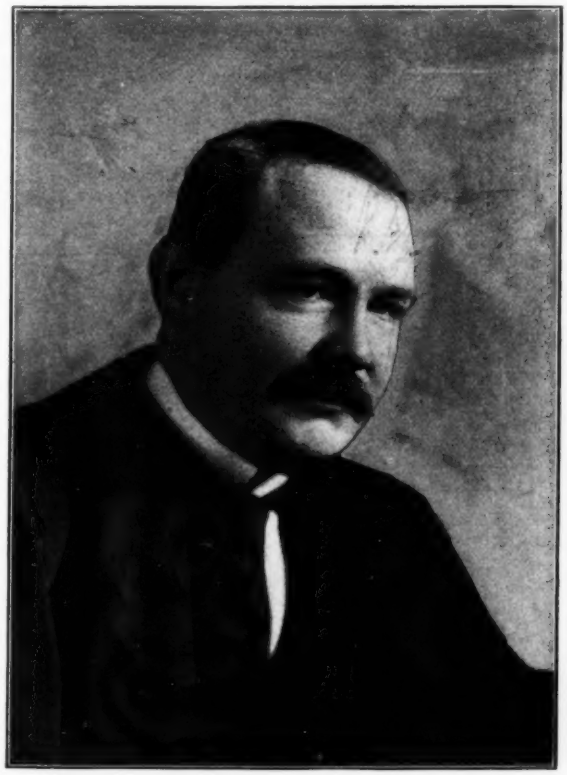
Edward E. McCall.

On February 3, William Sulzer, governor of the State of New York, nominated Edward E. McCall, a justice of the Supreme Court of the State of New York, to succeed William R. Willcox as chairman of the Public Service Commission of the First District. Mr. McCall's nomination was immediately confirmed by the State Senate and it is expected that he will begin his duties at once.

While not an engineer, Judge McCall is a very able, conscientious, practical man. He was born in Albany, N. Y., 50 years ago, the son of John and Katherine McCall. His brother, the late John A. McCall, was president of the New York Life Insurance Company, of which his son, John C. McCall, is now vice-president. After graduating from the Albany High School, Mr. McCall went to New York and studied law at the New York University, graduating in 1884 at the head of his class. He has acted as personal counsel to the head of many important corporations, a number of the big insurance and banking interests of New York being among his clients.

Justice McCall has always been interested in politics. In the first Cleveland campaign in 1883, he was an ardent worker for the success of the Democratic party, later on supporting Governor Hill and participating very actively in the state and national campaigns. He is a Tammany man, open and unashamed, and has held district offices in the Tammany organization. He was elected to the bench in 1902, and his record has stamped him as a jurist of unusual attainments. Two years ago he received from the Appellate Division of the Supreme Court the assignment much coveted by judges, although it entails much hard work, of hearing and deciding personal and corporation tax cases, including the assessments for state and municipal taxation of franchise values.

He is a member of the Society of Medical Jurisprudence, the New York Bar Association, and the Metropolitan Museum of Art. His clubs are the Manhattan, Lawyers, New York Athletic, Catholic, National Democratic, Columbia Yacht, Tilden and Lotos. In June of last year the University of New York conferred on him an honorary degree.



Edward E. McCall,
Chairman New York Public Service Commission, First District.

Wireless Telegraphy as an Aid to Rescue Work in Mines.

In a Blue Book on mines and quarries in the United Kingdom recently issued, reference is made to the possible use of wireless telegraphy in mines as an aid to rescue operations. Experiments in the North of England yielded success in communication between the surface and a depth of 800 feet.

Chicago Electric Club News.

Frederic P. Vose, of Chicago, entertained the members of the Electric Club, of Chicago, on January 30, with a very interesting lecture on the Panama Canal. Many lantern slides, made from negatives taken by Mr. Vose, were shown portraying various phases of life in the Canal Zone.

The meeting on February 6, will mark the close of the Club's fiscal year and will be given over largely to the election and installation of new officers.

White River Plant Near Completion.

The Ozark Power & Water Company expects to have its 15,000-horsepower hydroelectric plant on the White River in Southwestern Missouri ready for operation by April 15. This plant will supply Springfield, Mo., and a portion of its power will also be transmitted to Joplin.

Rates for Garaging Electric Vehicles Discussed at Chicago.

The regular weekly meeting of the Chicago Electric Vehicle Association was held on Tuesday, February 4, in the rooms of the Traffic Club at the La Salle Hotel. The meeting, which was of an informal nature, was one of the best attended of the regular weekly meetings. About 30 members were present.

George H. Jones, power engineer of the Commonwealth Edison Company, spoke briefly about his trip to the Pacific Coast, comparing the electric-vehicle situation there with that in Chicago. He mentioned the remarkable fact that in the city of Pasadena there is one electric pleasure vehicle for every 75 inhabitants. In the direction of commercial electric vehicles, however, the cities of the Central States are far ahead of those of the Coast.

Attention was called, by Homer Niesz, to a new electric garage recently started on Emerald Avenue, Chicago. From a standpoint of rates charged, this installation is an interesting one, as the method adopted was taken as being the most equitable yet put into practice. The charge is here divided into two portions; a fixed charge of $20 per month per vehicle for storage, adjustment and oiling, and an additional varying amount for charging. This second portion provides for power at the rate of 4.5 cents per kilowatt-hour for the first 300 kilowatt-hours, and four cents after that amount has been consumed.

Meter readings checked with miles give a very good basis for figuring out the ton-miles, or at least allow the car-miles to be accurately computed.

On this basis of rates the total charge for storing and charging a 1.5-ton delivery wagon will average about $45 a month.

In the course of the discussion following, it was stated by one of the members that there are now 533 commercial electric vehicles in operation and on order in the city of Chicago.

The next meeting of the Association will include a moving picture of a parade of the electric vehicles of the Commonwealth Edison Company. The meeting will be held at the La Salle Hotel.

The number of steamships required to carry wireless under the new law is estimated at 1,000.

Connecticut River Power Project.

The bill to authorize the Connecticut River Power Company to relocate and construct a dam across the Connecticut River above the village of Windsor Locks in the State of Connecticut, was introduced by Senator Brandegee on January 9, and referred to the Committee on Commerce. It was reported by Senator Burton without amendment on January 20. The majority of the Committee on Commerce recommended that the bill might pass. The provisions of this bill were reviewed in the ELECTRICAL REVIEW and WESTERN ELECTRICIAN of February 1, as was also the minority report of members of the Senate Commerce Committee. An amendment has been prepared intended to be proposed by Senator Jones. This is in the form of a compromise, which it is expected will be accepted between those standing out for state's rights and thost who urge the Federal Government's point of view. In the original bill it is provided "that the Secretary of War, as a part of the conditions and stipulations referred to may, in his discretion, impose a reasonable annual charge or return, to be paid by the corporation or its assigns to the United States, the proceeds thereof to be used for the development of navigation of the Connecticut River and the waters connected therewith. In fixing such charge, if any, the Secretary of War shall take into consideration the existing rights and property of said corporation and the amounts spent and required to be spent by it in improving the navigation of said river, and no charge shall be imposed which shall be such as to deprive the said corporation of a reasonable return on the fair value of such dam and appurtenant works and property, allowing for the cost of construction, maintenance and renewal, and for depreciation charges."

In the amendment intended to be proposed by Senator Jones, it is provided that all of the above enumerated section shall be stricken out and the following inserted: "The assent of Congress herein given shall not be complete and operative until there shall be filed with the Secretary of War an agreement signed by the said Connecticut River Power Company and the proper authorities of the State of Connecticut in which is recognized and acknowledged the full authority of the State of Connecticut to supervise, regulate, and control the rates to be charged by said company, its successors and assigns, for the energy developed and the right of said State from time to time to readjust such rates, and the right of said State to supervise, regulate, and control said corporation, its successors or assigns, its management, stocks, bonds, or evidences of indebtedness in such manner as may be provided from time to time by the laws of said State, and the right of said State to exact from said corporation, its successors or assigns, such annual charges as may be just and reasonable, taking into account the amount spent and required to be spent by said corporation in improving the navigation of said river, and the right of said corporation to a reasonable return on the fair value of such dam and appurtenances, works and property, allowing for the cost of construction, maintenance and renewal."

Association of Engineering Schools Formed.

The engineering divisions of the land-grant universities and colleges of the United States, of which there is usually one in each state, formed an association at a meeting held for that purpose in Washington, D. C., on January 24 and 25. The object of the association is to deal with problems peculiar to such institutions by reason of the Land Grant Act of Congress under which they are established, and also to co-operate with the Agricultural Association of the land-grant universities and colleges, which has been in active existence for many years.

The membership of the new association consists of the presidents of the institutions, the deans of the engineering divisions, and such other representatives as each president may select, but a single vote only is allowed each state represented. The United States Bureau of Education also has a right to representatives and a vote.

About two-thirds of the states were represented by the presence of one or more official delegates. These were largely deans of engineering and university presidents, but also included the United States Commissioner of Education with some of his staff. The delegates came from all sections of the country, including the far west and the most northerly and southerly sections.

The officers selected were: president, John Price Jackson, dean of the School of Engineering, the Pennsylvania State College; ex-officio vice-president, P. P. Claxton, commissioner of education of the United States; secretary-treasurer, A. Marston, dean of the Engineering Division of the Iowa State College; for members of the Executive Committee, in addition to the other officers, W. M. Riggs, president of Clemson Agricultural and Mechanical College of South Carolina; H. W. Tyler, professor of mathematics of the Massachusetts Institute of Technology; Albert W. Smith, dean of Sibley College of Cornell University, and G. W. Bissell, dean of engineering of the Michigan Agricultural College. C. H. Benjamin, dean of the School of Engineering of Purdue University, was appointed chairman of a committee, which is to be continued through the year, to consider certain of the public relations having to do with institutions of this class.

To Extend Telefunken System of Wireless Telegraphy.

Announcement is made that H. Bredow, managing director of the German Telefunken Wireless Telegraph Company, has arrived in the United States from Berlin in order to take up the question of establishing a transatlantic wireless service between the United States and Europe.

Since the year 1906 the German Telefunken Company has had an experimental station at the town of Nauen, near Berlin. The station has been enlarged and improved in the intervening years and now works with 500 to 600 horsepower as compared to 35 horsepower as originally installed in 1906. The result has been an increase in range from about 1,000 miles to as much as 4,000 miles. It is now intended to open this station for regular public service.

As early as a year ago it was planned to test the practicability of forwarding radiograms to the United States. The tower at Nauen, which was over 600 feet in height, was thrown over by a heavy storm before the tests were begun. At present a new tower, approximately 900 feet in height, is under construction in Nauen. The company had hoped, however, to bridge the ocean even before the completion of this tower and on January 11 began tests with a provisional antenna 400 feet high. The result was gratifying, for it is stated that at the first attempt the signals sent out from Nauen were distinctly received by the station at Sayville, L. I., belonging to the Atlantic Communication Company, of New York. Furthermore, the messages transmitted from Sayville were received at Nauen so as to be distinctly legible even though the station at Sayville operated with only about 45 horsepower.

Mr. Bredow has brought with him the latest inventions of Count Arco and his staff of assistants and he is of the opinion that in consequence of these inventions an important revolution will take place in the field of wireless telegraphy particularly, also in wireless telephony. Arrangements have been made between the German Telefunken Company and the Atlantic Communication Company for the testing of the new inventions at the plant at Sayville.

Chicago Jovian Lunch Club Formed.

Jovians of Chicago, under the leadership of George C. Richards, Statesman for Illinois, gathered in the German Room of the Grand Pacific Hotel on February 3 to discuss plans for forthcoming rejuvenations. Incidentally it was decided to form a permanent organization to be known as the Jovian Lunch Club, meetings to be held every Monday noon. At the meeting on February 3 volunteers for membership committees were called for and numerous applications considered.

Analysis of Central-Station Conditions in a Small Town.

Reduce the manufacturing costs is the watchword of the manager of every manufacturing industry, whether engaged in making cloth, shoes or electric power. This may be done in several ways, which are fundamentally but two: either stop wastes in the manufacturing process itself, or increase the output so as to decrease the fixed cost per unit. This latter method affords great opportunities for reduction in manufacturing costs. Every industrial manufacturer has recognized the fact that in case his output drops below some pre-determined value, practically all of his profits will be absorbed in manufacturing costs, while each central station has found that its load-factor must be about a certain figure or it will lose money. There is, however, this difference between the two cases: The manufacturer must continually be securing new orders and new customers to maintain the amount of his total sales, while the central station, after securing a customer, barring accident, enjoys a continuous revenue over an indefinite period of years and can devote its energy to other prospects, practically no effort being required so far as the old customer is concerned.

The economies and advantages of combining ice-making and steam heating with an electric plant are well known, but seldom are figures such as are given in this article available for publication. The operating features of the plant in question are worthy of a detailed analysis as they indicate the possibilities for central stations in small towns.

A central station that exemplifies the gratifying results obtainable by taking advantage of every opportunity for reducing manufacturing costs and increasing revenues is the Hillsboro Electric Light & Power Company of Hillsboro, Ill. This company has erected a modern turbine generating station embodying all of the refinements known to central-station engineering practice, and in conjunction with its electric light and power business supplies steam heat during the winter months and manufactures ice in the summer. The facts and figures accompanying this article testify to the economies and advantages of such combination plants.

The Hillsboro Electric Light & Power Company in addition to its local business, supplies electricity to several surrounding towns, namely Coffeen, Butler, Irving, Witt, Nakomis, Raymond and Harvel. Transmission lines are now also being built to Donnelson and to Morrisonville. The company also supplies energy to five coal mines and to a number of farmers north of Butler. Fig. 3 shows a map of the district supplied with the transmission lines from Hillsboro to the various towns. The total population of the territory served is 13,514, divided as follows: Hillsboro, 6,000; Coffeen, 980; Butler, 233; Irving, 978; Raymond, 881; Harvel, 396; Nakomis, 1,872; and Witt, 2,170. When the towns of Donnelson and Morrisonville are connected the total population served will be about 15,500. The dotted lines on the map indicate the lines now under construction. The transmission lines are single and three phase, operated at 16,500 volts. The distribution is at 2,200 volts in all the towns except Hillsboro, where it is 1,100 volts.

Fig. 1.—Power Plant of Hillsboro Electric Light & Power Co.

Fig. 2.—Engine Room of Hillsboro Power Plant.

Power Plant and Equipment.

The power plant of the Hillsboro company is a new modern one constructed in accordance with the latest practice. The building, 76 by 140 feet, is of brick and concrete construction designed to utilize the floor space in the most economical manner. The boilers, pumps, transformers and piping are located in the basement of the building with the ice plant, which occupies but a small section just south of the boiler room. On the floor above, which is on a level with the ground on the western section of the building, are the generating units, switchboard, freezing tanks and offices.

The boiler room measures 88 feet by 35 feet and is equipped with four water-tube boilers arranged in two batteries of two boilers each. Their approximate rating is 1,200 horsepower, each having 2,859 square feet of effective heating surface. The furnaces are hand fired, coal being dumped from cars directly in front of the boilers. The spur railroad track on which coal cars run, is 12 feet above the level of the boiler room floor and is so located that coal dumped from the cars falls into a storage space, 20 by 88 feet. This bin is separated from the boiler room by 6-foot arches, through which the coal passes by gravity into the boiler room, as needed. A minimum amount of handling is thus necessitated.

Each boiler is equipped with a water regulator for automatically controlling the water level, and there is also a meter installed on each boiler for measuring the amount of feed water used. A steel flue connects the furnaces with the reinforced stack, 150 feet high and 8 feet in diameter, shown in Fig. 1.

The water-supply system of the Hillsboro station is interesting, as unique methods had to be adopted for providing sufficient condensing water. The plant is located adjacent to an artificial lake from which a majority of the water is taken, a 16-inch cast-iron suction pipe running to the plant. From this main a four-inch line is run to the boiler-feed-water heater. A separate four-inch emergency line connects with a 20,000-gallon tank located on the roof of the plant. High-pressure fire mains and emergency supply lines to heaters, etc., are run from this tank. A cooling tower equipped with a steam-turbine-driven pump supplies all cooling and condensing water for the ice plant.

In Fig. 1 will be seen the Reummeli Dawley cooling tower, of 300,000 gallons capacity, equipped with a 7-foot fan driven by a 15-horsepower motor.

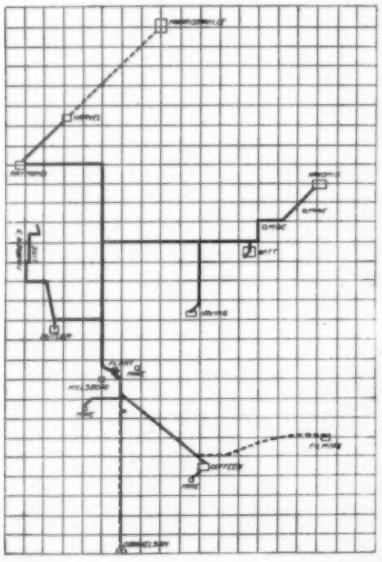


Fig. 3.—Map of Transmission Lines.

The steam piping in the plant in question is in accordance with most approved practice looking to uninterrupted service. A 10-inch, main header is connected to the boilers by 7-inch bends with extra-heavy valves and fittings. Two 9-inch mains run to the engine room and are connected by a 7-inch equalizing pipe. The piping is so arranged that any unit can be cut out without interrupting service.

A 12-inch exhaust-steam main in which all exhaust steam is collected is connected to a 10-inch heating main supplying the heating system. All turbines are taped in second stage for furnishing steam at five pounds for heating system. Each turbine is protected against excessive back pressure by a 12-inch Corchran multi-port relief valve. The ice machine is arranged to run with exhaust steam, taken from the 10-inch main, or from a separate main provided.

The pump equipment comprises two 10 by 5.5 by 10-inch Worthington center-packed duplex boiler-feed pumps; one 7 by 5 by 10-inch distilled-water pump for supplying ice plant and condenser water from turbines. There are two Worthington condensers installed, each capable of condensing 15,000 pounds of steam per hour. These condensers are equipped with pumps as follows: one 1,800-gallon volute pump driven by a 40-horsepower motor; one two-inch turbine-driven hot-well pump; and one 10 by 16 by 10-inch vacuum pump.

The engine room of the Hillsboro Electric Light & Power Company's plant contains two 750-kilowatt, 2,300-volt, 60-cycle alternators direct-connected to Curtis condensing steam turbines operating at a pressure of 150 pounds. One alternator is provided with a 35-kilowatt motor-driven exciter and one with a turbine-driven exciter of the same capacity.

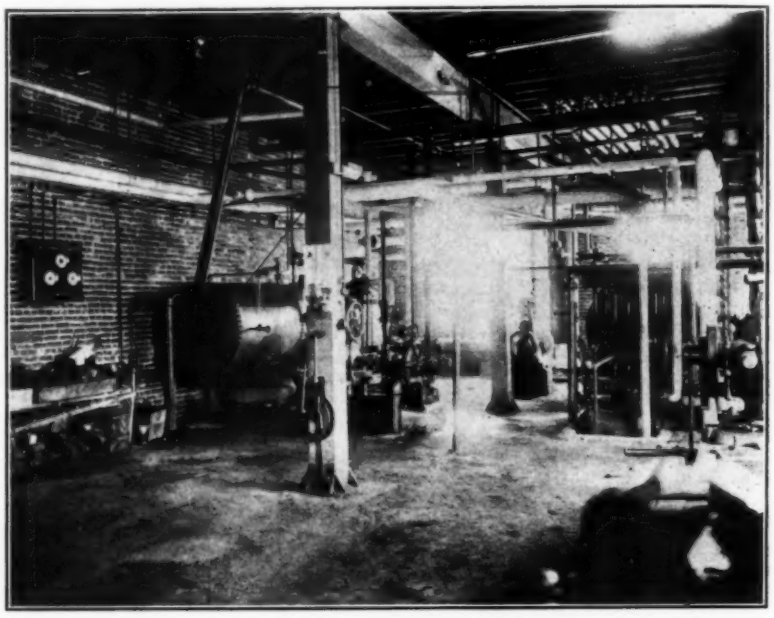


Fig. 4.—Ice Plant With Capacity of 30 Tons.

Fig. 5.—Freezing Tank.

For the street-railway business there is provided one 200-kilowatt, 600-volt direct-current, rotary converter, operat-

ing at 1,200 revolutions per minute.

The only equipment removed from the old station to the new, is a 250-kilowatt three-phase, 60-cycle, 2,200-volt alternator, direct-connected to a Chuse 20 by 20-inch reciprocating engine of 450-horsepower capacity.

Fig. 2 is a general view of the engine room interior and shows the arrangement of all equipment. The switchboard, of modern construction, is located adjacent to the north wall of the plant, and comprises 16 panels. These include three engine panels, three exciter, two railway, five distributing, one street lighting, one tie, and one regulator.

The plant is equipped with a machine regulator for generators and feeder regulators for the lighting circuits.

The generator panels are equipped with ammeters, wattmeters, volt meters and recording ammeters. Connections are made from these panels to the 2,200-volt bus, from where leads are run to three 200-kilovolt-ampere step-up transformers which increase the voltage to 16,500. All station wiring is run in conduit.

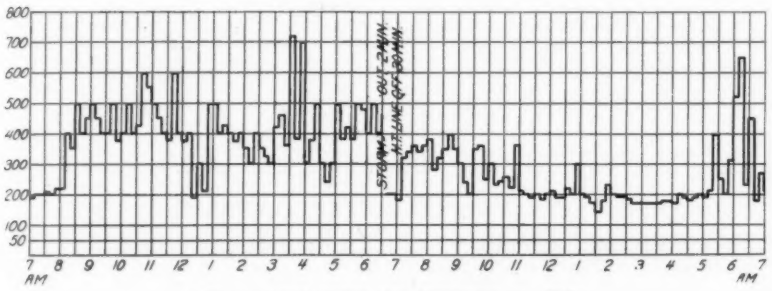


Fig. 6.—Load Curve for November 12, 1912.

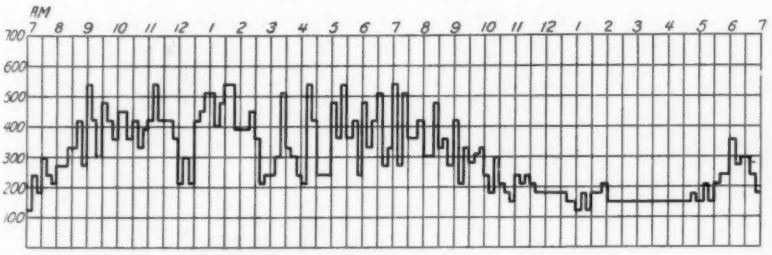


Fig. 7.—Load Curve for November 1, 1912.

Transmission.

The total mileage of transmission lines radiating from the Hillsboro station is 56, comprising 48 miles of high-tension lines and 8 miles of low-tension lines. The proposed extensions will, however, increase the former by 16 miles.

High-tension transmission is at 16,500 volts. Practically the same methods are used in the construction of all lines as follows: The poles are from 30 to 40 feet high, spaced 40 per mile. The regular length used on level ground is 30 feet, with 6-inch tops. All poles are of cedar and the tops and butts are treated with a preservative. At low places where sudden changes of grade occur, the longer poles are used to smooth out the line contour. The cross arms are 30 inches long and are fitted with galvanized lag screws and braces, each cross arm having the ordinary double brace of flat steel. The pins are of the standard type fitted with double petticoat porcelain insulators and the wire is hard-drawn copper.

Reference to the map, Fig. 3, will show a farmer's line running north from Butler towards Raymond. This is a 2,200-volt single-phase line built to serve about 11 customers who desire service. Twenty-five foot cedar poles, spaced 40 to the mile and No. 8 bare wire were used in building this line.

Cost data on this line are given in the following tables:

TABLE I. COST DATA ON FARMERS' LINE.

COST PER MILE OF LINE.		
533 lbs.—No. 8 Bare Wire at $15 per 100		$ 80.00
40—25 ft. 5 in. poles at $1.00+20c for treating		48.00
40—2-pin cross arms at $18.00 per 100	$7.20	
80—1½ x 9 in. pins at $1.25 per 100	1.00	
80—Old No. 22 Lima insulators at $4.00 per 100	3.20	
40—⅝ x 10 machine bolts, plain, at $6.00 per 100	2.40	
80—⅝ in. washers, plain, at $1.50 per 100	1.20	
80—⅜ x 4 in. bolts, plain, at $1.30 per 100	1.00	
40—½ x 3 in. lags, bolts, plain, at $2.00 per 100	.80	
80—20 x 1 x ¼ in. braces, plain, at $4.00 per 100	3.20	—20.00
4—Anchors and guy wire		5.00
Labor, freight, etc		47.00
Total per mile		$200.00

CONNECTION AT BUTLER.

1—10-kilowatt 2,200/220-volt transformer	$ 90.00
Lightning arresters, etc	10.00
200 lbs. No. 8 W. P. wire	30.00
Crossarms and labor	10.00
Total	$140.00

SERVICE CONNECTION.

1 kilowatt 2,200/110-volt transformer	$ 21.65
2—Single-phase 2,500-volt lightning arresters	6.10
1—Ground and wire	1.25
10 lbs. No. 8 W. P. wire	1.50
Brackets, bolts, etc	1.50
1—Meter	9.00
Labor	4.00
Total per customer	$ 44.00

TOTAL COSTS.

8.75 miles line at $200	$1,750.00
11 customers at $45.00	495.00
Butler service connection	140.00
	$2,385.00
Credit—11 customers, at $130.00	1,430.00
Net cost	$ 955.00

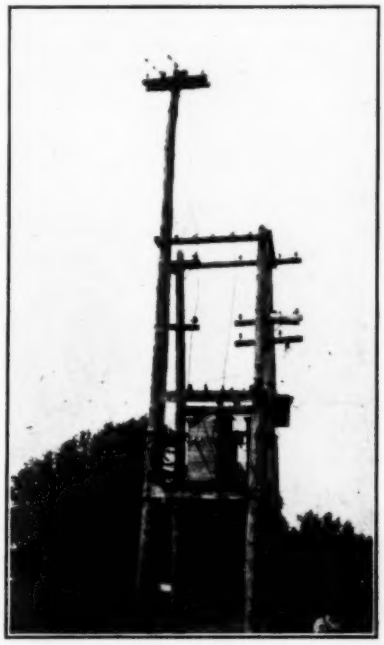


Fig. 8.—Pole-Type Substation on Farmer's Line.

High-tension lines terminate at the several towns in modern concrete substations. The average size of these substations is 16 by 12 feet and in each is carried supplies for customers and construction material.

The total rating of step-down transformers in substations and also at the various mines, served by the company, is 1,310 kilowatts, distributed as follows: Harvel, 50 kilowatts; Raymond, 50 kilowatts; Butler, 25 kilowatts; Nokomis, 75 kilowatts; Witt, 50 kilowatts; Irving, 20 kilowatts; Coffeen, 50 kilowatts; Witt mine, three 75-kilowatt transformers; Taylor Springs mine, three 175-kilowatt transformers; Coffeen mine, three 75-kilowatt transformers; and 15 kilowatts of transformer capacity on the farmers' line.

Distribution Systems.

The distribution in all towns is 2,200 volts. Hillsboro distribution has three feeders and a series street-lighting circuit carrying 6.6 amperes. On the Hillsboro street-lighting circuit are 38 6.6-ampere arc lamps and 43 75-watt series tungsten lamps. The street-lighting equipment in the other towns is shown in Table II.

TABLE II. STREET LIGHTING.

Town	Equipment
Harvel	27, 4-amp. 75-watt series tungsten
Raymond	19 6.6-amp. arc lamps
Nokomis	Energy sold to town
Witt	63 4-amp. 75-watt series tungsten
Irving	31 4-amp. 75-watt series tungsten
Coffeen	46 4-amp. 75-watt series tungsten

While all of the towns served by the Hillsboro Electric Light & Power Company are comparatively small, an enviable motor load has been built up. Table III shows the number of customers served in each town and also the aggregate motor load.

This table was compiled in August of 1912 and since then the town of Hillsboro has contracted with the company for city water pumping. This will increase the figures shown, considerably. Nokomis figures are not available as energy is sold to an independent company there.

TABLE III. MOTOR LOAD.

	Population	Number of Customers	Number of Customers per 1,000 Population	Horsepower in Motors
Hillsboro	6,000	629	105	973.75
Raymond	881	101	115	45.25
Harvel	400	43	107.5	60
Irving	978	90	92	15
Witt	2,170	133	61	353
Coffeen	980	120	122	31.75
Butler	233	31	133	20

TABLE IV. POWER RATES.

Under 100 kilowatts	6 cents
101 kilowatts to 300 kilowatts	5.5 cents
301 kilowatts to 500 kilowatts	5 cents
501 kilowatts to 750 kilowatts	4.5 cents
751 kilowatts to 1250 kilowatts	4 cents
1251 kilowatts to 2000 kilowatts	3.5 cents
2001 kilowatts to 3000 kilowatts	3 cents
3001 kilowatts to 4000 kilowatts	2.8 cents
4001 kilowatts to 5000 kilowatts	2.6 cents
5001 kilowatts to 6000 kilowatts	2.5 cents
6001 kilowatts to 7000 kilowatts	2.4 cents
7001 kilowatts to 8000 kilowatts	2.3 cents
8001 kilowatts to 10000 kilowatts	2.2 cents
10001 and over	2.1 cents

The power rate for energy is shown in Table IV.

A discount of 5 per cent from these rates is allowed if bills are paid on or before the fifth day of the month following that in which the power was used. A minimum charge is made proportional to the connected load.

Fig. 9.—Combination Telephone and Electric Light Pole.

Fig. 10.—Typical Substation.

Steam Heating.

Figures compiled at the close of the heating season last year showed that the steam-heating system, which contains 32,500 square feet of radiating surface, served buildings with a combined cubical content of 162,500,000 cubic feet. The number of feet of steam mains in service at the last count were 4,404.49 feet. The average monthly cost of the heating system is $245 and the average revenue $740 per month. This varies greatly, however, depending upon the temperature.

TABLE V. STEAM HEATING RATES.

Quantity per month.	Cost per 1,000 lbs.
First 5,000 pounds evaporation	50 cents
Second 5,000 pounds evaporation	40 cents
Over 10,000 pounds evaporation	35 cents

Note. 5 per cent discount for payment before the fifth of month.

The schedule of steam-heating rates now in force is given in Table V.

TABLE VII. REPORT OF GENERATION STATION FOR SEPTEMBER, 1912.

Coal consumed—Electric and ice	1,573,100 lbs.
Water evaporated	10,697,080 lbs.
Water evaporated per pound coal	68 lbs.
Kilowatt-hours delivered	200,280
Ice pulled	893,900 lbs.
Steam for ice plant	6,800,000 lbs.
Coal for ice plant	100,000 lbs.
Coal for electric	1,473,100 lbs.
Coal per kilowatt-hour	7.3 lbs.
Ice per ton of coal	8.94 tons

Electric. COSTS.	
Fuel	$582.38
	80.00
	135.00
Wages	525.00
	50.00
Supplies and expense	19.80
Repairs	3.06
Oil	10.00
Power used, lighting, etc	100.00
Total	$1,506.86
Cost per kilowatt hour	.0075
Ice.	
Fuel	$ 50.00
Wages	86.02
	11.68
Supplies and expense	8.40
Repairs	12.50
Motor Power	53.10
Oil	5.00
Total	$326.70
Cost per ton	.71

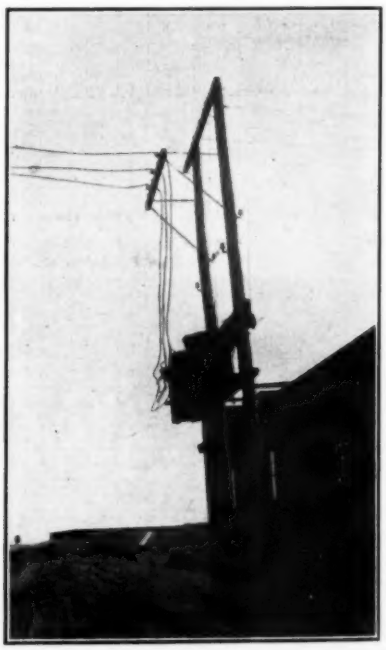


Fig. 11.—Typical Transformer Installation at Industrial Plant.

TABLE VI. COMPARATIVE REPORT OF GENERATING STATION.

	Kw. Hrs. 1908	Kw. Hrs. 1909	Kw. Hrs. 1910	Coal 1910	Cost Per Kwh.	Kw. Hrs. 1911	Coal 1911	Cost per Kwh.	Kw. Hrs. 1912	Coal 1912	Cost per Kwh.
January		36,597	38,957	598,000	.0167	71,422	954,400	.0113	77,408	870,950	.0113
February		31,274	36,360	575,000	.0179	56,174	838,060	.0136	77,747	1,441,160	.0135
March		31,411	37,304	581,000	.0178	60,696	937,620	.0147	126,095	1,530,500	.0087
April		26,979	35,458	518,100	.0188	60,050	936,500	.0148	119,915	1,700,000	.0138
May		24,563	32,688	465,500	.0207	60,22 7	795,210	.0129	114,375	1,240,000	.0136
June		24,203	34,594	443,500	.0207	58,113	812,100	.0133	111,920	1,202,400	.0136
July	22,882	26,483	41,940	628,340	.0144	64,913	714,260	.0124	123,237	1,344,000	.0095
August	24,454	28,202	58,940	764,220	.0126	70,614	767,300	.0108	190,660	1,776,300	.0084
September	26,872	32,311	56,575	857,360	.0263	71,237	1,120,500	.0138	200,280	1,473,100	.0075
October	31,506	33,694	63,490	783,100	.0117	79,044	1,105,000	.0132	209,145	2,300,595	.01
November	36,111	37,677	65,146	982,760	.012	75,799	1,331,740	.0151	.....	.....	.....
December	40,549	40,796	71,644	985,210	.0114	81,156	787,660	.011	.....	.....	.....

A flat rate of 25 cents per square foot of radiating surface is still in force with a few customers.

Operating Features.

An interesting report showing the output in kilowatt-hours of the Hillsboro plant with the corresponding coal consumption is shown in Table VI.

Eighty per cent of the energy generated is sold and accounted for. That which is not accounted for includes line, transformer and meter losses.

Load curves of the Hillsboro plant are shown in Figs. 6 and 7. These show the load in kilowatts and are interesting as indicating a peak during the morning hours equally as great as in the evening. Both curves were plotted during November 1912.

Table VII gives complete operating statistics and costs for the month of September, 1912, which month may be considered as typical.

Residential lighting rates are 15 cents per kilowatt-hour for the first 15 kilowatt-hours consumed per month, and 10 cents per kilowatt-hour for all energy consumed in excess of 15 kilowatt-hours. For commercial lighting the rates are 15 cents per kilowatt-hour for first 50 kilowatt-hours used per month and 6 cents per kilowatt-hour for all energy consumed in excess of this amount. Electric heating rates, when the devices used are on a separate circuit are 4 cents per kilowatt-hour. with a minimum charge of $2.00 per month. All of the above rates are subject to a discount of 5 per cent when bills are paid before the fifth of the month following that in which the energy was used.

The ice rates range from 40 cents per 100 pounds to $2.50 per ton for wholesale sales. The average income received, however, is 28 cents per 100 pounds. The cost of delivering ice in Hillsboro is approximately $1.00 per ton.

Table VIII gives the complete financial and operating data of the company for the month of October, 1912.

TABLE VIII.

Income—October, 1912.	
Commercial Lighting	$2,423.44
Commercial power	1,935.84
Street lighting	772.68
Profit on merchandise sales	404.68
Rents on real estate	45.00
Steam heat sales	743.57
Meter rent	185.00
Ice sales	815.41
Miscellaneous sales	87.56
Nokomis	412.00
Total sales	$7,825.18
Receipts	6,676.25
Customers' construction	1,257.21
Total charge on customers' ledger	8,664.14
Net profit	1,729.17

Expenses—October, 1912.	
Production.	
Station wages	$ 625.59
Fuel	974.53
Water	44.06
Lubricants	34.90
Station supplies and expense	103.72
Depreciation	193.33
Maintenance	676.66
Total	$2,653.79
Transmission.	
Supplies and expense	
Depreciation — Lines, substation buildings and substation equipment	$ 136.28
Maintenance	38.94
Total	$ 175.22
Distribution.	
Wages	$ 398.12
Supplies and expense	71.17
Depreciation—Lines, line transformers and meters	232.00
Maintenance	66.30
Total	$ 767.59
Ice Plant.	
Wages	$ 149.55
Fuel	27.50
Power	100.00
Supplies and expense	89.30
Depreciation	181.66
Maintenance	50.00
Total	$ 598.01
Steamheat Mains.	
Wages	$ 6.70
Fuel	100.00
Depreciation	106.83
Maintenance	30.22
Total	$ 242.75
Street Lighting System.	
Wages	
Supplies and expense	
Depreciation	$ 53.22
Maintenance	15.22
Total	$ 68.44
Depreciation—Other equipment	$ 10.50
Interest on bonds	500.00
Interest on bills payable	130.00
Insurance	125.00
Taxes	75.00
Bad accounts	10.00
Commercial Expense.	
Office salaries	$ 142.00
Supplies and expense	41.61
Postage and stationery	64.08
Total	$ 247.69
General salaries	$ 248.32
General expense	125.34
New business	49.50
Discount	69.86
Grand total	$6,096.01
Cash receipts less current expenses paid	736.62

The Hillsboro Electric Light & Power Company is under the general management of J. J. Frey, who is also president of the company. B. H. Walcher, secretary, has charge of all contracting and general office details. J. E. Strasbaugh, superintendent, has charge of the electrical department and lines, and Jesse L. Best holds the position of chief engineer, and has charge of power stations, steam heating and ice plant.

Commercial Practice
Management, Rates, New Business

THE USE OF A LARGE LIGHTING BATTERY IN CONNECTION WITH CENTRAL-STATION SUPPLY.[1]

By F. H. Whysall.

The figures and information presented herewith are based on results obtained in over two years' operation of a 12,000-ampere-hour battery installed in one of the plants of the Manchester Corporation Electricity Works. The battery has a maximum discharge of 15,000 amperes.

The battery consists of 210 cells, each cell containing 38 positive plates and 39 negative plates of the following dimensions: positive plates, 20.75 inches wide by 29 inches deep by 0.4 inch thick; negative plates, 20.75 inches wide by 29 inches deep by 0.31 inch thick.

The positive plates are of the Planté formation, cast in one piece but the negative plates are of the improved box type composed of half grids securely riveted together, the spaces between them being filled with active material. Specially impregnated wooden separators are employed between adjacent plates, and a free space of 8 inches is left at the bottom of the cell for the accumulation of deposit.

The cell boxes are of pitch-pine lined with lead, the outside dimensions of each box being as follows: length, 6 feet 1.5 inches; width, 2 feet 2.5 inches; height, 3 feet 4.5 inches.

The following are the guaranteed performances of the cells: maximum discharge rate, 15,000 amperes; one-hour discharge rate, 8,400 amperes (3,000 kilowatts); charging rate, 4,100 amperes; maximum charging rate, 6,500 amperes; maximum charging voltage, 2.75 volts per cell; ampere-hour efficiency, 90 per cent; watt-hour efficiency, 66 per cent at one-hour rate (8,400 amperes); watt-hour efficiency, 75 per cent at three-hour rate (3,900 amperes); final voltage per cell, 1.67 volts at one-hour rate; final voltage per cell, 1.78 volts at three-hour rate; weight of each cell and acid complete, 2 tons; weight of complete battery, 620 tons; floor space occupied, 5,966 square feet.

In the United States batteries are frequently installed large enough to supply the whole load of the system for a short time in case of a total failure of the gen-

[1] Taken from a paper presented before a meeting of the Institution of Electrical Engineers at London, Eng., January 23, 1913.

erating plant; but this is not usual in England. In such cases regulation by regulating cells is adopted, and in extreme emergencies the battery can be called upon to give an enormous discharge far exceeding its normal rating. It is important that the discharge should not be limited by the carrying capacity of the booster; a regulating switch can be overloaded to a much greater extent without any serious injury.

Further, when batteries are used only in case of breakdowns, if a reversible booster were used either the booster would have to run continuously with no load, or else when a sudden breakdown occurred the battery would not be immediately available. Where a battery is put in to reduce fluctuations in the load on the generators it is also looked upon as a standby, but this is not its principal function; further, at times of heavy load the reversible booster would in any case be running. The chief duty of the battery in question is to take 3,000 kilowatts off the lighting peak. It is also looked upon as a standby. But its chief duty is load-levelling.

Operating Costs.

It is necessary when considering the cost of generation of peak-load units to take into consideration the fact that the most uneconomical units are reserved for this duty, and quite rightly so, also that these peak-load sets will not be run at their most economical load; consequently the steam consumption will be high. Bare fuel cost per 1,000 kilowatts standby for this peak-load duty the author has estimated at $35 per week, or reckoning five days per week $7.00 per day. This latter charge becomes in the case of a 3,000-kilowatt battery $21.00 per day for the bare one-hour rating of the battery. But it is true that when considering the effect of the battery on load-factor, it is unfair to credit the battery with standby savings on its bare capacity only; and in one instance it was demonstrated that this battery saved standby to the extent of 44.5 per cent on the total boilers under steam at the beginning of the day, also that more boilers are necessary to meet sudden demands than can comfortably cope with an equivalent load applied gradually. We may safely assume, then, that on this occasion (during a storm) a 3,000-kilowatt battery saved standby for its own capacity plus 44.5 per cent of the boiler capacity prior to the storm, which was 7,200 kilowatts. On this, 44.5 per cent is 3,200 kilowatts. Calculating at the same rate without allowing anything for the increased price of coal, we see that the 3,000-killowatt battery at this time of the year, say, the five summer months from March 31 to September 1, is equal to steam standby at the rate of $42 per day. Reckoning on the basis of five days per week gives $4,620. Adding $3,150 to this on account of the standby saving for its own capacity for the other seven months, we have a yearly standby saving of $7,770.

Below are some observations at the city stations in corroboration of the author's estimate of standby charges over some months when steam standby had to be maintained. These figures were obtained by comparing the corresponding periods of the year previous when standby was not maintained.

Month	Tons of coal.	Cost.	Stand-by Kw.	Cost per week per 1,000 Kw.
April, 1911..	488	$1,275	8,000	$40
May, 1911..	203	525	5,000	25
June, 1911..	388	1,000	5,000	50
July, 1911...	504	1,315	8,000	40

It must be admitted that it is only fair to charge the battery with bare fuel costs corresponding to the input, because there is an actual saving on running fixed charges on the station when a battery is put in. The author supports this statement by saying that at Dickinson Street there are now 22 fewer men for an increased demand since the installation of the battery. Comparing bare fuel cost per unit generated, and crediting the battery with a commercial efficiency of 70 per cent, we get a cost per unit (reckoning 2.5 pounds of coal per unit at $2.93 per ton) of $0.0023 against a cost of $0.0155 taken from the actual results shown on the load-factor curve for 8 per cent load factor. The peak-load units discharged by the battery since its installation, calculated at the rate of five complete discharges per week are 1,560,000, and represent an annual saving of $42,670. This takes no account of the morning discharges and load-levelling duty during the rest of the day, commonly called "buffering," whereby each set on load is kept running at its most economical output, and sets do not need switching in and out to meet the vagaries of the demand.

The improvement in load-factor on the units generated, observed monthly over two years, is approximately 7.5 per cent, and the value obtained from the chart is $0.008 on 30,500,000 units; this represents a saving of $50,830.

We have, then, two distinct annual savings on running charges due to the battery: (1) Standby boiler fuel costs; and (2) difference between steam generation at 8 per cent load-factor and bare fuel cost.

The accompanying table shows saving on works costs for one year.

In the table the actual saving on plant costs for one complete year's operation is given, showing the saving actually made. Nothing has been said about battery maintenance so far; but it should be noted here that the makers have signed a contract to maintain the battery at its rated capacity for a term of fifteen years for the sum of $6,250 per annum, which is 8.3 per cent per annum on the purchase price. This maintenance is included in the works costs.

Capital Cost.

Saving in favor of battery: First cost, $147,165; annual charges, $5,280.

Annual Running Cost.

Saving in favor of battery:

As per first year's working under favorable conditions...	$38,100
Total annual saving in favor of battery.....	43,380
The estimated saving from calculated standby value was per annum.....	7,770
From difference in cost of generation between fuel cost and cost at 8 per cent load-factor	42,670
	$ 50,440
The estimated saving from load-factor improvement was	$ 50,830

When considering the value of storage batteries in connection with central-station supply, it has been the general custom in the past to compare the cost per kilowatt of capacity with that of steam plant and generator, to the advantage of the latter. It was argued that steam plant and generator cost less, and could be run continuously if required, whereas a battery (if the one-hour rating was used for comparison) was not to be relied on for longer periods than one hour. It was, and is still, held that the life of a battery would be less than half that of generating plant, that maintenance is exceedingly heavy, operation difficult, and still—speaking generally—a prolific source of worry and trouble.

Batteries were installed, when central stations were first built, large enough to maintain the supply during the night, and at the week-ends, without the assistance of running plant. They were found a great convenience; but generators would be added as the demand on the station grew, and the battery would fall out of use, except for balancing purposes, until, through neglect and ill-usage, it would become of no value to the scheme. In no case would the battery be used except as a luxury, and it was generally expected to require no attention until it got into a very bad state.

Electric traction did something to raise the reputation of storage batteries, owing to the marked saving in plant required

Year.	Output to Feeders.	Coal Used.	Average Price of Coal.	Increase in Coal Cost, 1910 and 1911.	Total Cost per Unit Output to Feeders.	Saving in 1910-11 against 1909.	Total Value of Saving Effected by Battery with Coal at $2.60.	Commercial Efficiency.
1909.	Kw-hours.	Tons.						Per Cent.
No battery.....	25,818,992	40,681	$2.51		0.368			
1910.								
With battery....	29,042,985	39,418	2.64	$820	0.305	$38,100	$38,920	70.6

Note.—Calorific value varies between 13,500 and 14,000 B. T. U. per pound.

for a rapidly fluctuating load, and the resultant economies of this buffering effect.

A properly proportioned battery is supposed to give one per cent to two per cent better ampere-hour efficiency when used on traction and as against the efficiency of a battery used to deal with lighting peaks, due to the greater buffering effect on traction loads.

It is now being recognized that, provided the battery is installed to reduce generating plant, it is a sound commercial proposition when considered in connection with a large lighting load.

Too much has been made in the past of the supposed inefficiency of batteries; as a matter of fact 70 per cent to 75 per cent commercial efficiency can be maintained with care; and if this were not so, efficiency is the least important attribute of peak-load plant, and especially so in the case of a battery. Peak-load units are costly to generate, and allowance is made for this in fixing charges for lighting. Power or daylight units are much lower in price because the cost of generation is much less—so in effect the battery is charged at power costs, and discharged at lighting rates. If some of our large consumers on public supply mains only realized this, they would install batteries of their own, buy current at power rates, and cheapen their own lighting supplies by arranging with the supply authorities for a "restricted-hour" supply, *i. e.* they would take no current from the mains at peak-load time.

Batteries hitherto have usually only been installed by consumers for the sake of making supplies reliable and independent of accidents outside their own premises.

It does not matter how short a period of time during the day, or the year for that matter, a supply is demanded, there must be plant installed to meet it, and it has been found that for all duty of less than 8 per cent daily load-factor, *i. e.* of less than two hours, demand during the 24 hours of the day, the matter is in no doubt. It most certainly pays to make storage-battery provision for this. Beyond this point we must look to advantages other than direct saving in capital cost and running charges to justify the extension of the principle.

It is often said, "What about the overload capacity of the steam plant; is not this sufficient to deal with the peak the battery is intended for?" On occasion, yes; but if reliability of supply is to be assured, the occasion must be that brought about by the failure of the battery, a possible but unlikely occasion if proper care is taken.

Booster regulating plant can go wrong, and batteries are protected normally by circuit-breakers which may open through defect. It is generally possible, however, in the event of serious trouble to parallel the battery without the boosters in circuit; and under such circumstances the battery would prevent total failure of supply under the worst conditions. From other causes of failure a battery is practically free.

It is very important that the battery should be of large enough capacity, not only for normal discharges, but for any short, heavy loads it may be called upon to give out. On the other hand, if the battery is larger than would be necessary to deal with load of the proportions indicated, the direct saving it is possible to show is correspondingly decreased.

Electricity in Construction Work.

An admirable plan, proving that electric lighting equipment of portable character is eminently practicable for use in extensive construction work demanding this sort of service for night as well as day work, has been evolved by the Ohio River Contract Company, of Evansville, Ind. This company is now engaged in the important work of widening the mouth of the Louisville & Portland Canal at Louisville, Ky., around the falls of the Ohio River, a project involving the expenditure of approximately one million dollars.

In arranging for night and day work at the head of the canal, where millions of cubic yards of earth are to be excavated and retaining walls of concrete are to be set, the Ohio River Contract Company has purchased curent from the Louisville Lighting Company and has supplied its forces with a portable set of lighting lines. The poles carrying the wires for the arcs and incandescents used are firm, but are not stationary, and may be moved about at the convenience of the engineers in charge of the work.

One of the first big construction jobs in Louisville, to be handled throughout with electrically-operated equipment is the new powerhouse of the Louisville Railway Company, which is being erected at Twenty-first and High Streets in that city and which will cost $750,000. The station is located on the bank of the Louisville & Portland Canal, securing water for its turbines from and discharging its waste into that channel. Extensive excavation and concrete work, including the construction of two lengthy tunnels to the cannal proper, has been demanded in laying the foundation for the power house, and electricity furnished by the Louisville Lighting Company figured prominently in this work.

The Henry Bickel Company, contractors for the excavating and concrete work about the station, used a 40-horsepower alternating-current motor in operating a number of air-compressors and drills demanded by the extensive excavation and tunneling in hand. A 15-horsepower alternating-current motor was employed to operate several saws and planers used in making the forms for the concrete work, and another 40-horsepower motor operated a centrifugal pump which drew the water from the cofferdams built at the mouths of the tunnels to the canal.

Complete electric lighting equipment, as a matter of course, was demanded by the contractors on the job, for during the past five months a 24-hour daily working schedule with three shifts of men has been employed. Half a dozen high-power arc lights at strategic points about the job furnished the illumination above ground and in the tunnels and deeper excavations where artificial light was necessary all day as well as at night, more than 250 32-candlepower incandescents were used. The work on the big powerhouse has thus been handled in a manner calculated to prove that electricity is now indispensable to the big building contractor.

Central-Station Power Replaces Oil in the Texas Oil Fields.

One of the paradoxical conditions of the oil industry is being witnessed in the Spindle Top (Texas) oil field. It is that of discarding the use of crude oil for fuel for the operation of the engines in pumping the wells and replacing it with electricity. It would naturally be expected that the producers of oil would find it cheap and advantageous to use that character of fuel in their own operations, but since the recent advance in the price of the product it is found much more economical, it is claimed, to operate the pumps by electric power than using oil for fuel to generate steam. Recently fourteen electric motors have been installed upon Spindle Top and are pumping more than 25 wells. It is claimed by those who have adopted this power that they are saving from 25 to 75 per cent in operating expenses as compared with steam power where fuel oil was used. Most of these motors are specially constructed for the purpose of developing 10-horsepower when pumping and 30-horsepower when "pulling" wells. By simply changing the switch the motor is transferred from the lower to the higher power with double speed. The motors are also being used to pump salt water from the wells into reservoirs. The adoption of electricity for power purposes in the Spindle Top oil field is attracting attention among oil men of other producing territory in Texas and other states and the new power method promises to become of general use.

Street Lighting in France.

Of 10,000 towns in France having more than 1,000 inhabitants, about 6,000 are without any public lighting. Of the remainder, 1,249 are lighted by gas, 2,763 by electricity, and 172 by acetylene.

Electrical Construction

CIRCUITS FOR ELEVATOR SIGNALING.—II.

Complete Installation For an Office Building.

In large office buildings it is customary to equip the elevators with signal lamps on each floor to give the waiting passenger notice of the approach of his car, and also with a signal in every car to be employed in calling the attention of the operator to the fact that passengers are waiting on a certain floor. The latter signal may likewise consist of an incandescent lamp. There may be signals, too, by means of which the elevator starter, or dispatcher, can call the operator of a car to bring his car from any position in its travel back to the starting floor, and there is sometimes a still further addition to the signaling system in the nature of indicators on certain floors to mark the position of each elevator in its hatchway and show the direction of travel at the moment. Where all of the signals mentioned are employed the arrangement of circuits is necessarily rather complicated—so much so, in fact, that a reader who had not given such circuits considerable thought already, would probably find it rather difficult to follow a complete description of the installation. In order to make it easier for the reader to follow the explanations of some of the more complex systems to be described in later papers of this series, there is inserted here a short account of certain features of construction and operation which are employed in perhaps most of the very complete systems of elevator signals. As a means of simplifying the discussion as much as possible, moreover, attempts to explain mechanical details will be avoided as far as possible.

A preceding article contained a discription of a commutator and brushes used to control the signal lamps in elevator service for department stores. That portion of Fig. 1 marked *Brush, u, p, d*, etc., may be considered a portion of a commutator similar to the one described there. To the left of the commutator are a mercury cup *P* and two electromagnets *R* and *M*. Two elevator cars are shown in the figure, and the signal lamps on what is assumed to be the sixth floor of the building. In each car an operator's signal lamp is shown, the one in car No. 1 being marked *H*. Two sources of electric current are employed in the diagram, one a dynamo *D* and the other a battery *B*. In practice, however, a motor-generator may be used instead of the battery, or, as will appear later, a single source of electromotive force may be made use of for all the signaling circuits.

Let it be assumed that car No. 1 is moving upward, and that the upper button of push-button switch *Sw* is pushed by a passenger waiting on the sixth floor. Current will flow from *B* through magnet *M* and switch *Sw* and back to the battery, thus energizing *M* and causing the armature of this magnet to be drawn to the left so as to allow the right-hand end of the lever shown in the figure to drop into the cup of mercury *P*. As was explained in connection with the discussion of elevator signals for department stores, the brushes *r, s, n*, etc., have a travel over the commutator which is controlled by the travel of the elevator car itself. As soon as car No. 1 passes the fourth floor, say, the brushes *s* and *n* make contact with the commutator segments *h* and *g*, and so complete an electric circuit from the dynamo *D* through the "up" signal lamps, near the left side

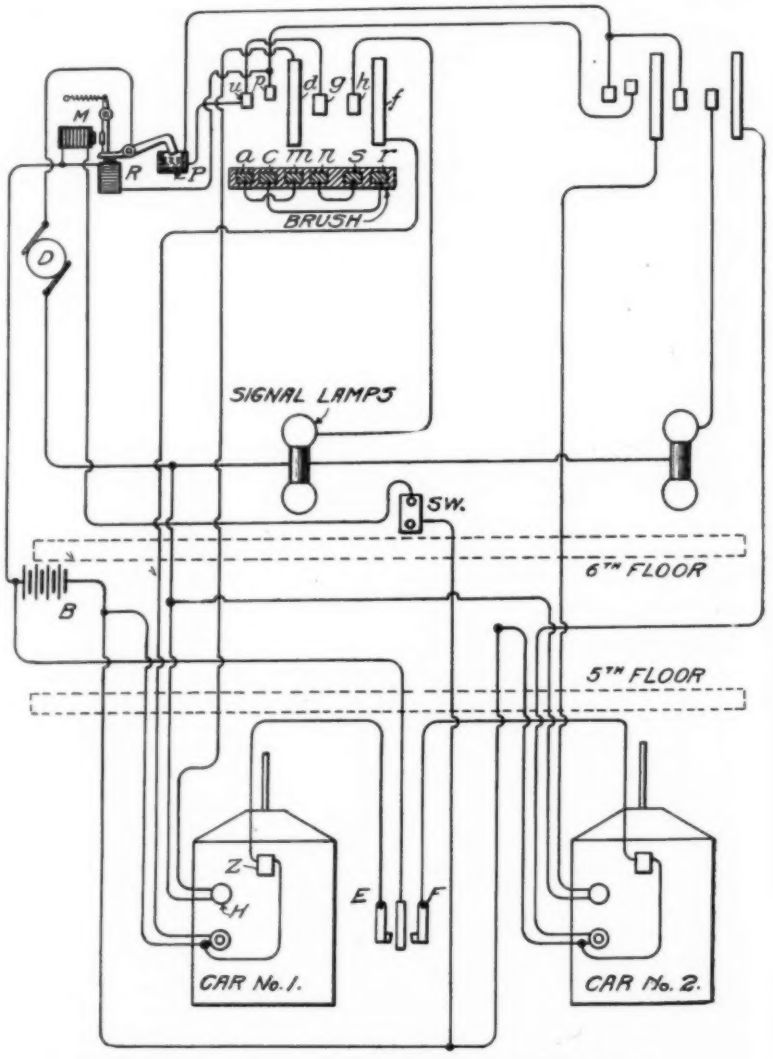


Fig. 1.—General Arrangement of Parts of Signaling Circuits.

of the diagram. As may be readily seen, the path of the current will be from *D*, through the lamp, thence to *h* and *g* and back to the dynamo by way of the mercury pot and the lever, the end of which rests in it. The lighting up of the lamp is a signal, of course, of the approach of the car.

Later in the travel of the car, but before it reaches the floor where the lamp is burning, the brushes are brought into such a position on the commutator as to establish electrical connection between contact *a* and segment *u*, and thus the circuit is closed from the generator *D* through the lamp *H* in car No. 1, the path of the current being *D-H-d-m-a-u* and back to the dynamo through the mercury contact and lever. By means of the lamp *H* the operator of the elevator has his attention called to the fact that he is expected to stop at the floor where the "up" lamp is burning.

As the car moves away from the sixth floor, contact is established between *c* and *p* and current flows from battery *B* through the transfer switch in the car, which is indicated as being located just below the lamp *H*, and thence through segment *f* of the commutator, and from here back to the battery over the path *r-c-p-R*. The magnet *R* is therefore energized and lifts the lever out of the mercury contact *P*, so as to open the circuits of the signal lamps.

In case the car No. 1 is already loaded so that no passengers can be taken on at the sixth floor, the operator of this elevator opens his transfer switch as soon as he gets the signal to stop, and the release magnet *R* is not energized. The arrangement is such in practice that after the transfer switch is opened the signals are automatically shifted to the next nearest car approaching the floor where the signal has been given, in an upward direction, the cross sections indicated in the diagram being provided for this special purpose.

The discussion here is confined to one floor; the equipment and operation for other floors is the same. The distance of the elevator when the signal is given from the floor where it is to stop is also assumed. In practice this will depend upon the arrangement of the control mechanism, which may usually be adjusted to suit the requirements of the service.

The two cars in Fig. 1 are represented as equipped with dispatcher's signals, the signal in car No. 1 being marked *Z*. The switches *E* and *F* control these two signals. The current is taken from *B*, as is easily seen from the diagram. Such signals are employed to call the car to the starting floor.

It is estimated that over 7,000,000 tungsten automobile lamps will be sold in this country this year, of which about 4,000,000 will be for renewals.

THE PRESENT STATUS OF GROUNDED SECONDARIES.[1]

By W. J. Canada.

Grounding of secondaries occupies an increasingly prominent position among protective methods used by electric-service companies in their distribution to customers. There has been much division of opinion and argument on this operating feature, which draws all its importance from its imputed virtue in preventing a life and fire hazard, otherwise existing in serious proportions on our ordinary energy distribution by alternating currents.

There has been a noticeable conservatism toward adoption of this alleged protection, on the part of underwriters, because of a claim, previously perhaps with some foundation, that grounding to protect life might increase fire hazard. Some lighting companies have from time to time opposed grounding because of supposedly greater predisposition of the grounded system to transformer breakdowns. It must be confessed that the positions of both manufacturers and engineering societies have been entirely consistent for this connection.

It is the more evident from this past discord that we need such general conviction that nothing can prevent general adoption of grounding if it is unmistakably necessary and unprejudicial, or the general rejection of grounding if it is futile or harmful.

As an indication that entrance of high potentials into buildings are a real problem confronting the electrical industry, we may state that the comparatively few cases brought to public notice include the following:

TABLE I.—INJURIES AND FIRES FROM HIGH VOLTAGE IN BUILDINGS.

Deaths in buildings from 2200 volts in five years, United States	149
Deaths in buildings from 2200 volts in five years, Colorado	29
Fires in buildings from 2200 volts in five year, United States	237
Fires in buildings from 2200 volts in five years, Colorado	61
Number of cities from which such deaths were reported	49
Number of cities from which such fires were reported	32

It should be stated that Colorado has by no means the unenviable high rank in fire and death losses or defective construction which the above list might indicate. The figures of Colorado are simply a better proportion of its actual troubles, obtained by the closest investigation of the underwriters, and the fullest co-operation of the Colorado Electric Light, Power & Railway Association, which has resulted, by the way, in an almost complete remedying of the hazards involved in these life and property losses. One city, for instance, had 49 fires and 9 death losses in three years from unusual secondary voltages, and can now show four years operation since adopting secondary grounding with but one such fire and one such death. In an October 1912 storm in a small Pennsylvania town, 21 minor fires were started by a primary cross on secondary network. Nor is this country alone in such experience. Among others we may cite a primary breakdown in 1909, in Italy, which in one town, killed 12, seriously injuring 29, and started over thirty fires. So serious an impression was made that the Italian Government offered a prize of large amount to the engineer offering the best design for prevention of such calamities.

[1] Part of a paper read at the annual convention of the Western Association of Electrical Inspectors.

Theoretical Considerations.

We may assume that grounding must have thoroughly proven its advantages, or no exploiting could have advanced it to such general acceptance as it now possesses. Its universal acceptance and adoption will follow only a united evidence for the ground connection by theory and practice.

First examine its theoretical relation to operation. A single-phase primary with thorough insulation on all legs, or rather with the same extremely small leak on each, will assume a potential relation such that each wire is at substantially equal potential difference from ground. The ungrounded secondary from this primary will for the same reasons assume the same voltage relations. Under these conditions, a person will hardly sustain an injury from contact with one secondary wire, since leakage current would be so small. Fire damage is out of the question. Personal contact with one primary, however, might readily be dangerous, not from power leakage, but from capacity effects. Fire damage from such a contact seems highly improbable, though about 400 times as probable as with secondary at one-twentieth voltage.

If now we have one secondary grounded at any point, either intentionally or otherwise, inside buildings or out, we have a condition by which injuries may be expected, and fires. This ground need not be better than one of 400 ohms resistance, although it might be of no resistance. In either case the human body in the circuit might be injured by either 50 volts, 100 volts or 220 volts, the necessary voltage being much less a factor than the contact, and a very small amperage enough to injure. The chance for fire is much less with poorer grounds, but is still considerable with say 100-ohm grounds, which would permit 2 amperes in a 220-volt secondary. Note that in ordinary practice such small grounds almost always exist, either in buildings or out, frequently on more than one wire at a time, and without causing comment. This can be taken as an axiom, or verified by the testimony of almost all operating companies. Even grounds of six or more amperes are so common as to

cause comment only when by accident a final house circuit happens to become a part of such circuit by grounding and blows a six-ampere fuse inside some building. It is thus safe to assert that a normal neutral ground is no more hazardous to life or property than the supposed underground condition. A preponderance in favor of normal neutral ground might be found in the fact that at least twice out of three times the better secondary ground must necessarily be, with supposedly ungrounded secondary, on an outer wire, subjecting life and property to 220-volt instead of 110-volt circuit hazards.

If we now suppose both primary wires entirely free from ground, but one primary wire in contact with a secondary, either underground or with one of the very poor grounds just mentioned, we again have—in the first event of entirely ungrounded secondary capacity hazard of the secondary raised toward the voltage of the primary—and in the second event of partially grounded secondary the same hazard as the secondary by itself.

If, however, we have a ground, even a poor one, a 400 ohm ground, say, on one primary, and such is so common an operating condition as to cause no comment at central stations, and we have also the other primary in contact with a secondary, through line cross, sleet and tree-contact leakage, or transformer break, the entirely ungrounded secondary rises to say 2,200 volts above the earth potential, and life or insulation in circuit between such secondary and grounded surfaces is subject to such voltage, with practically no amperage limit except that imposed by its own resistance and the resistance of primary ground. It should also be noted that a very small primary ground, say 10,000 ohms, would be deadly to life; while insulation, and separation of inside wiring are not calculated to avoid breakdown with arcs following from such voltages. Such an arc would not be cut out, even on a final six-ampere circuit, unless the primary ground were of less than 300 ohms, and in any event the ordinary 110-volt plug fuse might probably sustain an arc at this high voltage. The ordinary existing ground on supposedly ungrounded secondary will ordinarily operate to keep the secondary voltage considerably below the 2,200 volts of primary, but only a thorough and permanent ground can keep it reasonably close to its designed potential.

When we realize that almost all distributions are three-phase, and that the primary of each individual transformer no longer straddles earth potential, we see that conditions much more demand secondary grounding.

With the rapid increase in use of higher voltages on primaries, it is entirely reasonable to expect with well insulated 110-220-volt secondaries even the surely dangerous voltages of 600 and up. And it should be noted that with arcing primary grounds or even solid-grounding of one primary leg, even a 2,300-volt primary may introduce much higher potentials on secondaries. Such high potentials will usually prevent their own repetition, by soon forcing accidental grounds in buildings or out—but with all the fire and life hazard of such imperfect connections.

Even if we escape the forgoing troubles from both good insulation and from defective grounds, we find the trolley of grounded systems, the arc-light wire and transmission lines at every voltage always ready to cause high secondary voltages if the direct primary does not. If now secondary neutral has a normal low-resistance ground, no capacity to ground exists and no voltage to ground from this source can appear; no contact to ungrounded primary can raise secondary potential, for the same reason. A contact with one primary wire through transformer when another primary is grounded will cause current enough to pass through secondary winding of transformer to quickly blow primary fuse. If a primary wire makes contact to secondary outside the transformer, the same will occur, although the blowing of station or section primary fuse may then be necessitated. The effect of resistance in secondary ground will be later considered. In every case theory would tend to prove absolute immunity of well grounded secondaries to high voltage entrance.

Experience of Operators.

Apparently theory strongly indicates thorough grounding for safety. We naturally turn to practice to support theory or to locate its flaws, and will usually admit the engineering judgment of observing operators to have considerable weight in any investigation. It might be stated briefly that to obtain such a consensus of practice throughout this country, 140 service companies, representing every state and Canada, were written a series of questions, and from the one hundred odd replies received, the following give proof of the general satisfaction in all sections following adoption of grounding. Of the 55 companies grounding in the Rocky Mountain field only 11 are included in this list.

TABLE II.

Companies using grounding	86 or 87 percent
Expressing belief in grounding	92 or 96 per cent
Experience with grounding	average 5 years
Companies reporting advantages in grounding	69 or 85 per cent
Companies grounding above 110 volts	6
Companies' experience with grounding good	86 or 99 per cent
Companies utilizing mains	34 or 31 per cent
Companies utilizing driven pipes	52 or 48 per cent
Companies utilizing cones.	6 or 6 per cent
Companies utilizing plates	13 or 12 per cent
Companies utilizing tracks	3 or 3 per cent
Companies which prefer water mains	71 or 92 per cent
Companies interconnecting secondaries	33 or 49 per cent

That many companies recognize the ungrounded secondary as a fire and life hazard is proven by their own statements of experience with injuries and fires from high voltage on their secondaries, which for obvious reasons, cannot be given here. Of 49 cities from which deaths were reported, 41 are now partially or entirely grounded.

In the midst of this argument for grounding, which, if not logically opposed, should demand our unanimous and active support for such protection, it is necessary before arriving at our final decision to injure where opposition has developed to grounding. The strongest, and initially the sole, opposition has been that of the underwriters, and this may be said to have now changed to a decided preference. The later opposition has come more particularly from those lighting companies which either have suits pending, or the moral necessity for supporting their former defense of such suits.

Fortunately, later improvements in line and transformer construction have been made the basis of a revised recommendation by the grounding committee of the National Electric Light Association through its chairman, W. H. Blood, that grounding be made a mandatory requirement in the National Electrical Code where secondary voltage above ground cannot exceed 150 volts, leaving the grounding optional above that voltage. As the slight ground is an ever-present hazard even with the secondaries above 150 volts, the reliance on its absence creates a false sense of security. In the case where by grounding we have insured that only normal low voltages may enter buildings, isolation from such low voltages, whether 110 or 500, may be easily secured to prevent personal hazard, and insulation, for the property hazard. It is also readily seen that the fire hazard grows with the voltage, as well as does the life hazard, and it thus develops that an arbitrary limitation of grounding to 110-volt circuits would have removed any weight which such a Code rule could be given by fire insurance men as a fire safeguard, and would have left in much question the justification for demanding grounding as a life-hazard protection. As a matter of fact, many companies are finding the grounding advisable on their 440-volt, 3-phase circuits and are so installing them.

The thoroughness of the ground is a prime necessity, and it should be of such size as neither to burn loose in case of dead ground on opposite primary, nor to deteriorate from the passage of such amounts of current as the blowing of the largest primary fuse may necessitate. Failure to blow the fuse must, of course, subject the secondary to some voltage rise. If

200 amperes be taken as about the largest primary fuse in any given system, the ground on that feeder should easily accommodate that current.

Since the grounding should be permanently good enough to prevent more than say 125-per-cent voltage rise on secondary it is evident that with 200 amperes flowing from a primary-secondary contact to one ground 500 feet away at least No. 4 ground wire and neutral would be necessary. A No. 6 wire would cause a 40-volt rise. A resistance in ground connection, even so small as one ohm, would cause a 200-volt rise, which might readily be dangerous, and certainly does not accomplish the full purpose of grounding.

It seems quite evident that for real protection primaries must, then, be generally much smaller than 200-ampere capacity, or far better, that grounds on secondaries to this primary should be in such numbers and thoroughness as to give much less than one ohm resistance. The large proportion of companies using driven-pipe grounds would appear to indicate that such had given absolute satisfaction in the above respects were it not that a majority of these very companies state their distinct preference for the ground to water mains as much more thorough and rugged.

One engineer representing a large number of important operating companies writes, "Ground plates are better than nothing, but the ordinary connections to water mains, if properly made, are entirely satisfactory, and driven pipes can be made satisfactory where soil is moist and where enough pipes are driven."

Many in substance write: "We regard grounds to water pipes as very desirable, but they are not permitted by our water company." Others add, "We use driven pipes (or cones or plates). These methods are not highly satisfactory, but we feel that by placing such grounds close enough, the combined effect of all gives us a decided element of protection." A few companies claim to find their practice of grounding secondaries frequently to rail returns satisfactory protection.

It generally appears that in very wet places the driven-pipe ground in sufficient numbers and well spaced will give the necessary low resistance and fair life. In all other cases, and especially where few grounds must be depended on for protection against crosses with heavy primaries, the water-main ground is without a rival. Such cities as Denver or Los Angeles could not get any effective service from other forms of ground. Only the best available grounds should be made, since the neutral may by a direct cross with primary be raised to a sufficient potential above water or gas pipes in buildings to cause fire and indirectly life hazard by breakdown to such piping systems, or by high-resistance contacts with them.

Another difficulty, rare, but still occurring, is that caused by small grounds, such as pipes, cones or plates, even where reasonably numerous in locations, where soil freezes to a considerable depth. In this case, the earth surrounding the "ground" becomes practically an insulator. The grounding loses its nature as such, and in event of surface thaw severe shocks have been given between this poor ground and the better conducting top surface.

All this seems to demand that secondaries should be not only grounded, but very well grounded, and further appears to indicate that water-main grounds should be insisted on unless they bring about difficulties of more seriousness than their popularity would indicate.

Possible Disadvantages of Water-Main Grounds.

Very little aversion has originated in service companies themselves to water-main grounds. But one company out of over one hundred writing considers the water-main ground even to water-service pipes of buildings unfavorably, as making possible current exchange between water mains and secondary grounds at different potentials. Four operating companies state they have noticed such an exchange. No companies, however, have noted harmful results, some claiming freedom from noticeable direct current on secondaries, even where rail return grounds are used, and any possible trouble has been avoided in the rare cases noted by betterment of rail bonding. Grounding, and water pipe grounding, so far seem to be strongly indicated.

Electrolysis of Service Connections.

From several readings taken by the writer he would conclude that direct current on secondaries can never, when secondary connections to water mains are intact, reach an amount at which perceptible electrolytic action begins, even with salt solutions, to say nothing of the ordinary soil conditions. While there is always existing the possibility that some direct current may be shunted over paths including secondary grounds, it is also apparent from theoretical consideration and experience that such shunting will rarely cause any injury to such grounds, either from heating or from electrolysis and that undoubtedly greater current flows must be expected from varying voltages between incoming gas, water and drain pipes, because of the greater conductivity of these.

Relation of Conduit Grounding to Secondary Grounding.

Contacts of direct-current wires within conduit may be expected to utilize conduit to some degree as portion of circuit. If contact be of neutral, current path is through conduit to its water pipe ground to help balance any uneven loading in the building. If contact be of outer wire, current path will be through conduit pipe to same neutral and may be expected to quickly blow circuit or feeder fuse, according to location and severity of ground. With a very poor ground in the latter case the fuse might not blow, and with very little unbalancing in the former case current would be very small, in either case not enough to harm conduit, since any large amount of current could only result from such unbalancing as to mean a large proportion of load on one side cutout by open fuse or broken wire, a condition readily seen and quickly corrected. Aside from possible damage in those cases where conduit should be buried in damp concrete, such moderate amounts of direct currents would certainly not injure the conduit itself in any way.

The evidence at hand seems to give a very decided preference to the use, in addition to outside grounding on water pipes, of inside grounds, and particularly the ground to conduit at point near the conduit ground itself.

For Grimy Hands.

As an electrician I have been troubled by what seems almost an impossibility to get my hands clean after working on some makes of wires, around motors that have been used and are oily, and in various other places. The grime seems to be driven right into the skin, and scrubbing does not entirely remove it. Some time ago I saw a recipe, but only within a few weeks have I tried it. It is as follows:

Mix four ounces of alcohol (grain alcohol), three ounces of glycerine and three ounces of water. Rub some of this solution into the hands in the morning. It quickly dries in, and then no matter how dirty one's hands get, ordinary washing with soap and water brings off all the dirt. The theory, I believe, is that the pores of the skin, and around the nails, are filled with this mixture and the oil and dirt does not penetrate. At any rate, by using this solution on the hands one can go to his meals, even at noon when time to wash is limited, with hands as clean and white as a woman's. It would be good for machinists, blacksmiths, etc., I believe, as well as electricians.

C. W. Goddard.

State Licenses for Electricians Proposed in California.

An effort is being made in California to have enacted a state law which will make it a misdemeanor for any person to engage in the business of installing electric wires and apparatus, or to do business as an electrician or electrical contractor without a license granted by a board of examiners, which the Governor will appoint if the proposed act becomes a law. It is intended that the state board of electrical examiners shall consist of five members, two to serve for one year, two for two years, and one to serve for three years, and these members must be persons skilled in the installation of electrical work, and who have been engaged in such work for at least five years preceding the date of their respective appointments. The plan is to have the examining board meet four times a year, or more frequently if necessary, in the city of Sacramento and at such other times and places as the business may require.

The fee for a license, as stated in the proposed act, will be $25, to be paid by the applicant at the time of his examination for a license, but when a license has been granted it may be renewed at the end of each year by the payment of a fee of $10, all licenses being for a term of one year. The penalty for engaging in electrical work in the state without a license is a fine of not less than $25 nor more than $100, or imprisonment for not less than five days nor more than sixty days in the county jail, or by both such fine and imprisonment.

Electrical Work in Kansas State Capitol Criticized.

E. J. Stewart, city electrical inspector at Topeka, Kan., recently sent a communication to the city commissioners in which he warned them that the electric wiring in the state capitol was in such a condition as to be a menace to the property of the state in Topeka and to other property adjacent to the capitol. It was stated that the wiring was none too good to begin with, and that it had deteriorated badly in the long time in which it has been in service. Mr. Stewart asked the co-operation of the city commissioners to bring the matter before the legislature. His suggestion was read and it was moved that the communication be referred to the Secretary of State, with request that he take such steps as seemed necessary to bring the matter before the Legislature with a view to securing ample appropriation to carry out the suggestions of the letter.

Change in Management of Central Electric Company of Peoria.

The Central Electric Company of Peoria, Ill., which is one of the most prosperous electrical contracting and merchandising concerns in the city, will hereafter be managed by L. B. Van Nuys, who for some time past has been the assistant manager. O. H. Norton, who established the company and was at the head of it for 20 years or so, has sold the business and retired, this step being made necessary by the loss of his eyesight. Mr. Van Nuys and Charles D. Brainard were the purchasers.

Although one of the youngest men in the contracting business, Mr. Van Nuys is widely known among the electrical contractors all over Illinois, and those who know him recognize him as a good type of aggressive, well informed electrical man. He is a native of Peoria. As associate manager of the Central Electric Company, he displayed such ability and tactfulness as to cause his acquaintances to feel sure that even a larger measure of prosperity than the company has heretofore enjoyed is now in store for it.

Among the Contractors.

The McFell Electric Company, of Chicago, is wiring a building for E. J. Selman in that city for 625 incandescent lamps and about 40 horsepower in electric motors.

The W. S. Rosenfeld Electric Company, of Baltimore, Md., has been awarded the electrical contract for decorations for the automobile show, which is to be held in that city from February 18 to 22.

W. H. Brown, of Chicago, is wiring the Devoe & Reynolds building, in this city, for 1,000 incandescent lamps.

The Home Electric Company, Louisville, Ky., has recently wired two high-class residences at Anchorage, Ky., and has contracted for another in South Louisville.

The contract for the electrical work in the new third ward school building in Dubuque, Iowa, has been awarded to F. H. Bissman, of St. Louis, Mo., the contract price being $1,800.

The firm of Henry Newgard & Company, of Chicago, has been awarded the contract for the installation of the circuits for 500 incandescent lamps and one motor in a building owned by H. J. Patten in that city.

The Kingsbury-Samuel Electric Company has been awarded the contract for installing the breakdown service in two of the largest department stores of Baltimore, Md. This contract is a very large one, and a quantity of 2,000,000-circular-mil cable will be used.

The contract for the electrical work in the Renbey & Tillroth building, Chicago, has been awarded to the Alloway Electric Company, of that city. About 600 lamps will be installed.

The firm of L. H. Lamont & Company, 160 North Fifth avenue, Chicago, has been awarded the contract for the electrical work in two Chicago public school buildings. One of these buildings will be a conduit job throughout and the other a mixed job of conduit and metal molding.

The electrical contracting firm of Sullivan & Phillips, of New Orleans, has just finished the wiring and fixture installation in the building of the new twelfth ward industrial school in that city.

Out-of-town work, as well as plenty of local business, is making things hum for Herbrick and Lawrence, well known electrical contractors of Nashville, Tenn. The firm has placed crews at work on theater wiring of importance in Richmond, Va., and in Birmingham, Ala.

James D. Thomas, 32 East Franklin Street, Waynesburg, Pa., has been awarded the contract for the electrical work in the plant of the Waynesburg Pressed Steel Company. A complete installation will be put in including a number of motors and the circuits for them.

The Crescent Electric Company, of New Orleans, is putting in the wiring in the French school building of the "Fourteenth of July Society," New Orleans. This company is also rewiring the building occupied jointly by the Commercial-Germania Trust & Savings Bank and the Commercial National Bank.

Don A. Tolbert, of Ada, Okla., has been awarded the contract by the City Council of Stonewall for installing an electric light system at that place.

The Electric Supply Company, Gulfport, Miss., has the contract for wiring the new Central High School in Biloxi, Miss. J. W. E. Robinson is the owner of this company.

The Standard Electric & Machinery Company, a prominent electrical contracting firm of Nashville, Tenn., recently secured a contract for rewiring complete and furnishing certain motor installation in the remodeling of the old Broadway National Bank Building in the Tennessee capital.

Childers & Waters, who have been established for a number of years on Fourth Avenue north of Main Street, Louisville, Ky., have decided to take new and more commodious quarters on Main Street east of Fourth Avenue.

The Joseph M. Zamoiske Company has been awarded the contract for wiring the Walbrook Methodist Episcopal Church in Baltimore, Md. This is a large contract, as the church will be one of the largest in that city. Galvanized conduit will be used and about 10,000 feet will be necessary for the job.

Having recovered completely from the effects of its recent submersion by reason of the mid-January flood in the Ohio River, the Marine Electric Company, of Louisville, Ky., has resumed business briskly and landed a contract to wire the new Roman Catholic Church of St. Bridget, in the Highlands.

The Board of Education of Newark, N. J., has awarded the contract for the electrical work in the new South Side High School building to the Stehlin-Miller-Henes Company, of New York, at a price of $13,775. The Jaehnie Gas Fixture Company, of Newark, will furnish the electric fixtures for the building, the cost of which will be $3,825.

Among the electrical installations either recently completed by the Standard Electric Construction Company, of New Orleans, or those which the company now has under way are the wiring in the United States Immigration Station near New Orleans, that in the Casino and boathouse at City Park, that of the new pumping station of the sewerage and water board, and the work in six new school buildings in New Orleans.

Bruce P. Yeager, electrical contractor, has recently completed the wiring in the new Charles Steele School building, Northumberland, Pa. The class rooms in this building are brilliantly lighted with Mazda lamps and Luceo reflectors. The lighting installation and the wiring have been especially complimented by those who have inspected the work, it is stated.

The Central Electric Company, of Hattiesburg, Miss., successors to the Dalton Electric Company, recently completed the wiring and the installation of fixtures in the buildings of the new Mississippi State Normal School at Hattiesburg. The contract amounted to approximately $10,000. P. J. Guerin is the manager of the company.

The Crawley Electric Company, of Peoria, Ill., is rewiring the stock rooms of the Peoria Public Library, and also one of the buildings of the Peoria & Pekin Railway. Another important installation by the company mentioned is the electrical work in the Peoria State Hospital for the Insane. In all of these jobs conduit work is employed exclusively.

Guy Carlton.

An excellent illustration of how success in the business world may be won by pluck and perseverance is seen in the career of Guy Carlton, of Bloomington, Ill. Mr. Carlton was born in the city just mentioned on September 9, 1877. He attended the public schools in his home town until he was 15 years old, at which age he was practically thrown upon his own resources in the matter of selecting a vocation and earning a living. He had a natural inclination for electrical work, which inclination he began to indulge when he was only 12 years old by installing electric door bells and gas-lighting apparatus. He was soon securing so much work of this kind that he opened a small shop over his father's livery barn, and not long thereafter began installing wiring for electric lights, this being long before the use of iron conduits was introduced in electric wiring practice. By hard and constant study he familiarized himself with the details of electrical con-

Guy Carlton.

struction and of the electrical contracting business. He also acquired practical skill in telephone work, and for three and a half years was instrument and switchboard man for the local telephone company.

Mr. Carlton's electrical construction business grew to such proportions that in 1902 he was compelled to seek larger quarters for his office, shop and store than he had previously occupied. At that time he opened one of the most complete display rooms in the state, the location selected being one of the best business sections of Bloomington. From the first, he kept his stock of electrical goods complete and up to date. Soon after opening his store, he added a complete line of electrical fixtures and began to pay especial attention to pushing the sale of these through vigorous, systematic advertising. Sample fixtures were arranged in a large display room in such a way that the prospective customer could see just how any fixture would look in actual service, and no effort was spared to induce patrons of electric service to visit the show room and inspect the stock. In this way a profitable fixture business was built up, which continues in steadily increasing volume. A jobbing department has also been added to the store. The aim is to supply everything usually found in stores of the kind.

Mr. Carlton is a member of the National Electrical Contractors' Association, and of the Illinois Association of Electrical Contractors. He attends the meetings of these as regularly as his business will permit, and takes a lively interest in such matters as come up for consideration there. Among local organizations, he has membership in the Bloomington Club, the Commercial Club, the McLean County Automobile Club, and other similar bodies. He is also a prominent member of the Odd Fellows order.

A piece of electrical work which Mr. Carlton can well afford to be proud of, as any visitor to Bloomington will attest, was the installation there of over two hundred 5-lamp ornamental tungsten lighting standards, these being placed on the more prominent streets. But this is but one of the many high-class jobs of electrical work he has done. He is a good type of the successful contractor. He has hosts of friends who are rejoicing in his success, for they know he deserves it.

Suggestion for Changing Height of Meters.

The following quotation is from a letter written by an electrical contractor to the manager of the central station in his town:

"At this time of the year, the contractors are usually not over-rushed with work. Get your meter readers to make out a list of customers with high meter locations. Turn these over to the contractors and have them call on the customers, presenting arguments for the lowering of the meters, such as the liability of the incorrect reading of the meter, the marring of chairs in getting upon them, the dirt dropped from the shoes, while climbing on the chairs, etc. Then have a clerk call up the various parties, recommending that the change be made, etc. This will not only enable your meter readers to cover more territory per day, but strengthen the good feeling between the company and the contractors."

The suggestion is an interesting one, and one which contractors in other localities than that referred to might do well to consider.

A. E. Anderson.

The total imports of copper into the United States during the year 1912 were 176,000 tons, compared with 152,000 tons in 1911. The total exports of copper in 1912 were 327,965 tons, compared with 336,801 tons in 1911.

Dollar Wiring Kinks.

Every reader is invited to contribute to this column. It does not matter how few words are used to explain a "Dollar Wiring Kink," provided the idea is made clear; and if a diagram is necessary, a rough pencil drawing will serve. The idea itself must, of course, be new and bright. A dollar will be sent to the contributor upon publication.

An Interesting Job of Fixture Hanging.

Fig. 1 illustrates the method I adopted in the installation of the lighting fixtures in a hall having a high ceiling with an unfinished attic above it. It will be noted that the job of putting up the fixtures was done without the use of any staging built up from the floor whatever, the erection of which would have been expensive and otherwise undesirable.

Having determined the location of the ceiling outlets by careful measurements, I cut a one-inch hole in the ceiling at each outlet, cutting downward from the attic above. Directly over this hole I spiked a piece of 2 by 4-inch timber between the joists, in which I bored a one-inch hole in the same vertical line as the hole in the ceiling. Then I screwed a 4-inch round outlet box on the timber mentioned, with the center knockout over the hole in the timber, and into this outlet box the conduit—which was run on the tops of the joists—was brought.

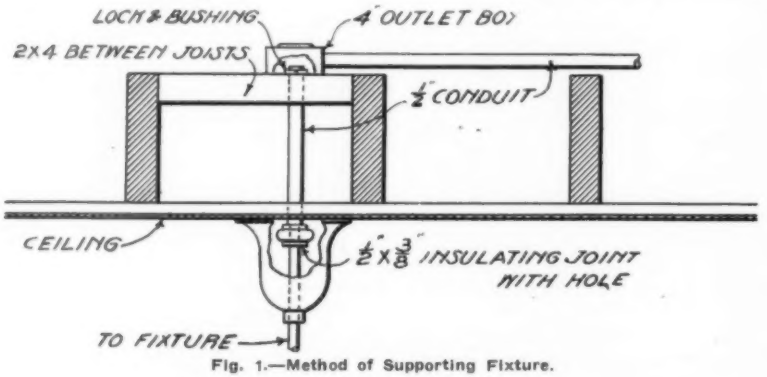


Fig. 1.—Method of Supporting Fixture.

A piece of half-inch conduit was then cut the proper length to reach from the outlet box to the ceiling, and, both ends of this pipe having been threaded, it was screwed to the fixture by means of a ½ by ⅜-inch insulating joint of the kind used for combination fixtures. Then I assembled the fixture completely on the floor, running the fixture wires up through the insulating joint and the piece of conduit, after which I pulled the fixture up with a rope spliced to the wires. A half-inch check-nut and bushing were screwed onto the pipe, and thus the fixture was held in place. Finally, the joints in the box were made, and the box covered with a closed cover. C. W. Higinbotham.

Design of Bell Circuits.

In the issue of January 4, I noticed a wiring kink having the above title, by George A. Hull. It seemed to me that Fig. 3 of this article was incorrect, or, at least, that such an arrangement of circuits would be undesirable, since the two bells would ring in multiple. My way of wiring this circuit is to use three-point switches arranged as in Fig. 2. This arrangement is such that only one bell will ring at a time.

C. C. Sisson.

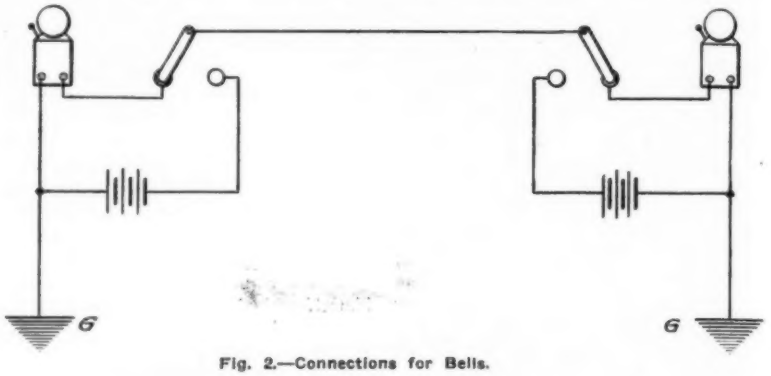


Fig. 2.—Connections for Bells.

Running a Difficult Circuit.

With reference to the article by A. Whitman which appeared under the above heading in the issue of December 28 I wish to make a suggestion or two.

One hole of the size Mr. Whitman mentions—namely, three-quarters of an inch—would have been quite sufficient to run a single circuit from the attic into the basement. By using No. 14 or No. 12 steel-armored cable and the proper terminal fittings the job in question could have been done at a cost not greater than what it must have cost as Mr. Whitman did it; and, furthermore, the cable installation would have been strictly a Code job. V. Spath.

Making the Fixture Hang Vertical.

I see many fixtures hanging on a slant—or that have been bent—which could have been installed so as to hang in a vertical position. When I hang fixtures from gas pipes which are installed on a slant I screw a cap or a coupling on the pipe—so as to preserve the threads—and then I take a pipe about four or five feet long which is wide enough to slip over the cap and gas pipe, and with little pressure the gas pipe can be bent so as to allow the fixture to hang vertical.

When a fixture-stud box is set on a slant I use a brass hickey. This bends easily and saves bending the stem of the fixture. Joseph B. Josephson.

Jointing Aluminum Wires.

Electricians who work with aluminum wires will find the following method of jointing such wires helpful. Fig. 3 is a photograph of a joint made in the manner described.

Cut the wires off square, and place them on a small slab of charcoal with the ends touching. Apply heat from a blow lamp on the two ends of wire. When they are red hot put on a flux made of aluminum hydrate and borax. Heat till wires get pasty; then place ends of wire firmly together. They should then unite freely. Draw off heat and let the wires cool. Then the joint will only want trimming. This joint will stand strain or bending.

Fig. 3.—Aluminum Wires Jointed.

J. M. Bradley.

Defective Wiring at Nashville.

The Tennessee Inspection Bureau, of Nashville, proposes to take action in readjusting the fire-insurance rates of these cities, increasing the cost of protection. Inspectors of the Bureau have filed reports stating that defective wiring is responsible for several hundred bad risks in each city.

Among the Supply Men

New Orleans Electric Appliance Company Has Big Evening.

There is no doubt about the esprit de corps of the management and employees of the Electric Appliance Company of New Orleans. This enterprising organization maintains a degree of efficiency in handling its business that may well be emulated by even those assured of the most conspicuous success. For many years the annual banquet of the company has been a custom of the house. The entire organization from its president and general manager down to the newest addition, including the office boy, get their feet under the table together and for the time being become one big enthusiastic family. A commentary of the happy situation thus evolved is the fact that of those employees present in 1912, all but three were again in attendance at the festal board in 1913.

The annual banquet of the New Orleans branch of the Electric Appliance Company, was held on the evening of Thursday, January 9. The festivities were opened by C. R. Churchhill, president and general manager, who insisted that the evening be given over to relaxation and jollification, and that business be absolutely cut from the program. A toast by Will Stacey of the Bryant Electric Company, to Mr. Churchill aroused the first enthusiasm, Mr. Churchill responding to the toast "To the absent officers of the company and our ever cherished friend W. D. Packard." Mr. Stacey delighted everyone with his rendition of the Stein Song, and was followed by N. A. Wolcott, who eulogized Mr. Churchill in what the attendants at the banquet considered were "high-efficiency" terms. The married men then on request entertained the rest of the guests with several vocal selections.

H. C. Russel made a few remarks on loyalty and co-operation, followed by H. H. Rowland of the Adams-Bagnall Electric Company. At this juncture Bob Mitten of the Chicago house, could no longer contain himself and insisted on making a speech. Mr. Stacey was called upon again and sang his ever popular ballad "Keep on the Sunny Side." Short talks were given by Messsrs. Mary, Trask and Hutson. J. F. Jones of the Wagner Electric Manufacturing Company tried to induce the party to listen to a declaration on "Wagner Quality," on the plea that he was not indulging in business because it was a pleasure for him to talk in that strain.

The banquet was held promptly after the close of the salesmen's school of the New Orleans house. During the conferences addresses had been made by the representatives of the manufacturers of the various lines handled by the house, and the following gentlemen were in attendance at the banquet: W. A. McCombs, Pittsburgh Reinforcing Pole Company; DeWitt Carter, Indiana Rubber & Insulated Wire Company; J. F. Jones, Wagner Electric Manufacturing Company; Robert S. Mitten, Electric Appliance Company, Chicago; C. M. Crofoot, Crouse Hinds Company; Omar Brasher, Sangamo Electric Company; J. W. Fulton, Fulton-McCutchan Company; W. A. Stacey, Bryant Electric Company; N. A. Wolcott, Packard Electric Company; Fred L. Warner, Holophane Glass Works; H. D. Rowland, Adams-Bagnall Electric Company; W. M. Skiff, Packard Lamp Works; Robert Kuhn, American Electrical Heater Company.

The menu was a work of art and greatly pleased all those present. A reproduction of the front cover forms the accompanying illustration.

The officers of the Electric Appliance Company of New Orleans, are C. R. Churchill, president and general manager, W. W. Low and Thomas I. Stacey.

Front Cover of Menu, Electric Appliance Company Banquet.

Percival Stern, who has been general manager of the Interstate Electric Company of New Orleans since its organization about 10 years ago, has bought out the other leading interests in the company and is now owner of practically the entire organization. The company does a large jobbing business in electrical supplies throughout the south and it is stated that its policies will continue as heretofore.

The Union Electric Co., of which J. A. Hallifield is manager, has just opened a place of business at 18 South Water Street, Mobile, Ala., and will do a jobbing business in electrical supplies.

C. P. Hill, secretary and manager, of the Doubleday-Hill Electric Company, Pittsburgh, Pa., announces that his company has been appointed distributing agent for Bosch magnetos and spark plugs, its territory to cover western Pennsylvania and West Virginia. He reports that business is better at present than it has been for several years.

R. J. Dinwoody, formerly manager of the Capitol Electric Company, is now associated with the sales department of the Inter-Mountain Electric Company, Salt Lake City, Utah.

Public Service Commissions

MARYLAND.

The Public Service Commission has granted the Consolidated Gas, Electric Light & Power Company permission to make a new issue of $6,360,054 of common stock with which to retire a like amount of preferred stock. This will bring the total issue of common stock up to $14,860,054. The application brought up again the fight for a further reduction in the prices of gas and electricity. Albert C. Ritchie, people's advocate in the recent rate cases, opposed the granting of the company's application. It was shown at the hearings in the rate cases that all the stock of the company and a good many of the bonds were water and represented no tangible values. It is true that the company had issued $1,500,000 of stock under the authority of the Commission for cash, but this was offset three or four times by the large quantities of water in the bonds of the company.

At the rates ordered it was estimated that the company's revenues would be $6,091,887, or $537,601 more than its actual needs for operating charges and fixed charges on bonds. This amount, it was figured, would allow for the regular dividends of 6 per cent on the preferred and 2 per cent on the common stock. Mr. Ritchie argued that the plan of refinancing meant the putting of the common stock on a six-per-cent basis, an admitted fact, and he held that the Commission had been misled in fixing its rates as to the probable revenues of the company. He insisted that a further reduction in rates should be made. The preferred stock of the company is callable on reasonable notice at 120 and it is necessary for the company to put the common stock on a six-per-cent basis and hold out a prospect of an increase in that to make the preferred stockholders willing to give up their preferred stock, which is a lien on the property, for the new common. Furthermore, the Commission in its order forbids the company to sell any of the new common for less than 120, if it has to sell in order to buy in the preferred. The order giving authority to issue the new common was drawn by General Counsel Bruce of the Commission at the request of Commissioner Timanus, who with Commissioner Hering signed it. Chairman Laird of the commission refused to sign the order. It is generally understood that the order precludes the probability for a long time at least of rates lower than those just ordered and also precludes the possibility of reducing dividends on the common stock or of ever squeezing any of the water out of that class of stock. The selling of any of the new class of stock for cash, and it is expected that several millions of it will be sold, will so mix that which represents no actual value with that for which money has been paid as to make a separation in the future impossible.

In putting all the stock on a six-per-cent basis the company figures on paying out in dividends next year $849,605, instead of the $537,601 allowed for that purpose in the calculations of the Commission, and $104,852 more than the $744,749 paid in dividends last year when the common paid five per cent. Thus, instead of being a cut of from 5 to 2 per cent as the Commission calculated would be the case, the common is increased to 6. This means that the company will take the difference between the $849,605, the amount required for its dividends under the new plan and the $537,601 estimated by the Commission as applicable to dividends—a difference of $312,044—from the reserve funds, or it will make that much more money than the Commission calculated.

The contention of Mr. Ritchie was this. If the company intends taking this money from the reserve funds, that shows the amount allowed for reserve was too high and the customers and not the stockholders should benefit by scaling them; if the company expects to make more money than the Commission calculated under the new rates, then the consumers should benefit by that, for the Commission has decided that the preservation of credit of the company does not need more than was calculated and that the company has no property on which it should earn rightfully even the first allowance. Therefore by giving the people that which Mr. Ritchie claimed to be their due, the Commission could reduce the gas to a flat rate of 70 cents. This would not allow for any change in the rate for electricity. But if the amount was applied to a reduction in both gas and electricity, it would mean 75-cent gas and 7.5-cent electricity.

The desire of the company to exchange its preferred stock for common is to get the preferred, which is a lien on the property of the company, out of the way, so that it can sell its 4.5-per-cent debenture stock in Europe. By the sale of debentures abroad, President Aldred expects to do the future financing of the company. The day after the order of the Commission authorizing the issue of new common stock was made, the directors of the company held a meeting and put the common on a six-per-cent basis.

The annual report of the Commission has just been submitted to Governor Goldsborough. The report calls attention to the death on December 24 of Louis M. Duvall, who had been secretary of the Commission from the time it was organized, and the selection of Benjamin T. Fendall, a former member of the Commission, as his successor.

The report shows that in the course of the year, the total number of cases disposed of was 442, in 203 of which there were formal hearings.

A number of proceedings have been instituted in the courts to review the findings of the Commission. Among these are:

By the Philadelphia, Baltimore and Washington Railroad Company from the order directing it to repair and operate the branch road from Worton to Nicholson, in Kent County. This case involves the power of the Commission to order the repair and operation of a branch line after non-use extending over a number of years, and which the Company alleges can only be operated at a loss.

By the Chamber of Commerce of Baltimore from the order establishing telephone rates, and attacking the constitutionality of the Public Service Commission Law.

By Maurice Gregg from a finding of the Commission in relation to the repeal of statutory rates in force prior to the passage of the Public Service Commission Law. This case was dismissed by the Circuit Court and appeal has been taken to the Court of Appeals.

In the operation of electric railways the killed number 37, an increase of 2; the injured 7,732, an increase of 870.

Of 30 electric meters tested on complaint, 9 were fast and 16 slow.

The assistant general counsel Albert C. Ritchie has been assigned to a number of cases, but so far only one—that of the Consolidated Gas Electric Light & Power Company of Baltimore—has been tried under its provisions, and it is, therefore, too soon to speak in an authoritative way of its practical operation. The suggestion has been made that

the officer in charge of such cases should not be a member of the Commission's staff, but entirely independent of it, and the Commission agrees with that opinion.

MASSACHUSETTS.

The Massachusetts Gas and Electric Light Commission has approved the issue by the Fall River Electric Light Company of 2,000 shares of new capital stock at the price of $150 per share, the par value being $100 per share. The proceeds are to be applied to the cancellation of obligations represented by promissory notes. On May 18, 1910, the Board approved of an issue of 2,000 shares of new capital stock on account of additions to the plant made prior to December 31, 1909. Since then the company's expenditures for additions to plant up to December 31, 1912, have amounted to $643,528. At the latter date it had outstanding promissory notes for $835,000.

The Board has also approved of the issue by the Amherst Gas Company, of 750 shares of new capital stock at $100 per share, the par value, the proceeds to be applied to the cancellation of promissory notes outstanding. On March 9, 1912, the Board approved an issue by this company of new capital stock of a par value of $50,000 on account of expenditures upon plant prior to July 1, 1911. Between June 30, 1911, and December 31, 1912, the company has expended more than $81,000 in further additions to its electric and gas plants. It had out-standing on the latter date promissory notes for $145,000.

Hearings have been held by the Massachusetts Legislative Committee on Mercantile Affairs on a bill which has as its object the transfer of the supervision of telephone and telegraph companies from the Highway Commission to the Gas and Electric Light Commission. The bill gives the supervising board power to change service and rates.

The Massachusetts Railroad Commission has certified that the requirements of law preliminary to the establishment of the Boston & Eastern Electric Railway Company have been complied with. The treasurer of the association for the formation of the company states to the Board that there is now in his hands $2,175,000 for use in constructing the proposed line between Boston and Salem, Danvers and Beverly, Mass. In addition to the sum named above, ten per cent of the capital stock of $250,000 has been paid in by the associates to said agreement, for the formation of the company.

The estimated cost of construction of the road, which has an aggregate length of 20.5 miles, including a branch, and of the tunnel under Boston harbor, together with the terminals, bridges, stations, ties and rails, and the cost of real estate, is given as $12,974,696.

NEW YORK.

It was expected that the Public Service Commission for the First District would this week finish consideration of the new subway contracts with the Interborough Rapid Transit Company and the New York Municipal Railway Corporation (Brooklyn Rapid Transit), and transmit them to the Board of Estimate and Apportionment for the approval of that body. Under these contracts the Dual System of rapid transit, as planned by the Commission, is to be built and operated. It will cost more than $300,000,000 and will treble the rapid-transit facilities of Greater New York.

The Commission has granted the application of the New York Municipal Railway Corporation for permission to issue $100,000 of its capital stock for the acquisition of property, improvements, extensions, etc. The company has a total capital of $1,000,000, but none of it has yet been issued. Later the Commission adopted another order granting the New York Consolidated Railroad Company permission to purchase the stock of the New York Municipal Railway Corporation when issued. Both companies were organized by Brooklyn Rapid Transit interests to facilitate their participation in the proposed dual system of rapid transit. The New York Municipal Railway Corporation will make the contract with the city for the operation and a contribution to the construction of the new lines. The New York Consolidated Railroad Company is the owner of the existing Brooklyn elevated system, and will take over the contract made by the New York Municipal Railway Corporation and operate the new lines.

The Public Service Commission, Second District, has denied the application of the Deer River Power Company for authority to issue $50,000 of stock in place of $25,000 previously authorized by the Commission.

The Commission has authorized the Schodack Light & Power Corporation to commence construction and to exercise a franchise in the town of Schodack, Rensselaer County, N. Y.

The Commission has authorized the Salmon River Power Company to issue its 40-year five-per-cent gold coupon bonds to the amount, par value, of $882,000, to be sold for cash and not less than 85 per cent of par value, and the proceeds used for the construction of three dykes, hydraulic and electrical equipment, transmission line, raising of dam and various other items in connection with the development of the company's property.

INDIANA.

Representative W. W. Spencer, of Indianapolis, Ind., will probably introduce a public-utility measure in the Indiana Legislature, now in session. The bill is regarded as an adminstration measure, for it embodies the views of Governor Ralston as regards public-utility legislation. Three propositions in this connection are considered by Governor Ralston to be vital. The first of these is the physical valuation of property held by public-service corporations and the others refer to indeterminate franchises and the consolidation of companies. The proposed commission is to have mandatory powers over utilities.

NEW JERSEY.

The Board of Public Utility Commissioners has issued an order which increases the rate of fare to be charged by what is know as the "Johnson Trolley" operating between Trenton and Princeton. After a consideration of the value of the property and the receipts and expenditures of the companies the Board reached the conclusion that the ten-cent fare heretofore charged is not sufficient to justify the operation of the road under the present conditions.

The Board has issued an order following hearing upon the complaint of the Postal Telegraph-Cable Company, which directs the New York Telephone Company to discontinue the use of the word "telegram" as a call word for the Western Union Telegraph Company. The order directs the New York Telephone Company to assign to the Postal Telegraph-Cable Company and the Western Union Telegraph Company call words as used by other subscribers and in addition thereto to assign the word "Postal" as a call for the Postal Telegraph-Cable Company, and the words "Western Union" as a call for the Western Union Telegraph Company. The order of the Board follows closely the order recently made following investigation of a similar complaint by the Public Service Commission of New York. The order of the New Jersey Commission goes beyond that of the New York Commission in that the New York Telephone Company is ordered to adopt, and enforce the rule which will result as follows:

(*a*) If an inquirer asks of an exchange operator for telephonic connection with a telegraph company not subscribing to the exchange, the inquirer shall be informed of the fact of such non-subscription, and of the telegraph company, or companies, subscribers to said exchange, in the alphabetical order in which the names of such subscribing telegraph companies appear in the printed telephone directory.

(*b*) Where an inquiry is made for telephonic connection with a designated telegraph company, and said designated telegraph company does not answer promptly, the inquirer shall be apprised of the situation; and at the inquirer's request so to do, and so only, the exchange operator shall designate the other telegraph companies that can be reached

through the exchange, naming them in the order indicated in (*a*).

(*c*) Where an inquirer informs the exchange operator of the inquirer's desire to transmit a telegram, but either fails to indicate the telegraph company to be employed, or expresses indifference thereto, the exchange operator shall desist from directing or advising or designating any particular telegraph company, and shall inform the inquirer that the inquirer must designate the telegraph company to be employed. The operator shall name the company or companies connecting with the exchange, in the same order as designated in (*a*) and shall connect only at the inquirer's specific designation of telegraph company.

The Board has authorized the transfer of a majority of stock of the Electric Company of New Jersey, (recently formed by the consolidation of the Salem Electric Company and the Gloucester County Electric Company) to the Electric Securities Company of New Jersey. The holding corporation was recently incorporated with a capital of $125,000, and headquarters at Camden; John A. Riggins is registered state agent.

OKLAHOMA.

On complaint of Senator Gid Garrett of Fort Gibson, the Oklahoma Corporation Commission has ordered the telephone rates between Oklahoma City and Fort Gibson reduced from 80 to 75 cents. It is claimed that the former rate was a discrimination as compared with other points equally distant.

That rural party telephone lines shall pay switching charges in advance quarterly, and that the telephone company has the right to discontinue service for nonpayment, is the substance of an order promulgated by the Oklahoma Corporation Commission. In making the rule, the Commission stated that it had sought to agree upon a reasonable plan, and that if objectionable features arise later, such questions will be heard and acted upon promptly.

INTERSTATE COMMERCE COMMISSION.

In view of the fact that, for some time past, complaints have been received by the Interstate Commerce Commission to the effect that the American Telephone & Telegraph Company and its allied companies are attempting to monopolize the telephone and telegraph business of the United States and, in doing so, are fast driving out of existence the independent companies who are its competitors, and that this and other companies are guilty of unlawful discriminations, and the imposition of unreasonable rates, rules, and practices in the conduct of their business; and following the action of the Attorney-General, the Commission has started an inquiry which it is to be presumed will delve deep and long into the history, financial operations, rates, rules, regulations and practices of the telephone and telegraph companies subject to the provisions of the Act to Regulate Commerce, with a view of making a comprehensive report and the issuance of such order or orders as may be deemed necessary in order to correct such discriminations and for the application of reasonable rates and practices.

In line with its decision to investigate the history and present conditions of the American Telephone & Telegraph Company, an investigation will be made into the local commercial telephone service in Pittsburgh, Pa., as it has been brought to the attention of the Commission that under certain unexpired contracts the company is granting to certain citizens of Pittsburgh, unlimited service at a flat rate of $125 per year, while at the same time exacting a higher rate to other parties. An investigation will be made to consider, first, whether the matters complained of are such as the Commission can take cognizance and control of. If that point should be determined favorably to itself, it will then proceed to an investigation of all the circumstances governing and controlling this business in Pittsburgh.

Marconi Company Seeks Cancellation of Contract with English Government.

The Marconi Wireless Telegraph Company, Limited, has asked the British Government to cancel its contract for the establishment of Imperial wireless stations, according to dispatches from London, in view of the expense caused by the unexpected delay in the fulfillment of the contract. Godfrey Isaacs, managing director of the Marconi Company, has addressed a communication to the Postmaster-General deploring the necessity of a highly technical scientific inquiry and complaining of the expense to which the company has been put and will be under if this inquiry is continued for an indefinite period. He therefore respectfully suggests that the Government agree to the company's treating the contract as no longer binding upon the part of either party so that the engineers of the company may be free to attend to other important work. Mr. Isaacs states that the company will be prepared when the investigation is completed to devote its whole energy, experience and staff to the construction of Imperial stations on such terms as may be then agreed upon if the Government should so desire.

Electrocution in Vermont.

The legislature of Vermont has passed a bill to substitute electrocution for hanging in that state. Governor Fletcher has signed the measure.

Questions and Answers.

All readers of the Electrical Review and Western Electrician are invited to submit questions and answers to this department. Full names will not be printed except where the writer indicates his willingness therefor. Anonymous communications will not be considered. Questions relating to electrical matters of any kind will be inserted. Answers from our readers should be received in this office preferably within ten days of the date of publication of the question, and will be published in a subsequent issue. Payment will be made for all answers published.

Questions.

No. 115.—Oil Switch.—What causes a type F, form H3, 300-ampere, 15,000-volt, General Electric oil switch to close from itself when tripped for the opening position and to open from itself when tripped for a closed position?—C. W. J., Chicago, Ill.

No. 119.—Mechanical Rectifiers.—What is the efficiency of vibrating and similar mechanical rectifiers compared with that of mercury-arc rectifiers? What is the highest current that can be rectified by them without destructive sparking? Can they be used on circuits higher than 110 volts?—J. B. D., Springfield, Mo.

No. 120.—Electric Bleaching.—I have heard the statement made that some laundries whiten or bleach the clothes artificially by sending electric current through a tank into which the clothes are put before drying. Where is this method used and how is it carried out?—M. C., Erie, Pa.

No. 123.—Scrap Value of Tungsten Lamps.—I understand that tungsten is an expensive metal and therefore wish to find out whether burned-out or broken-filament tungsten lamps have any scrap value. What firms, if any, buy them? Can they be refilled like carbon-filament lamps?—T. N. S., Sandusky, O.

No. 124.—Vehicle-Battery Charging.—What is the most reliable device to cut off the charge on an electric vehicle battery automatically when the battery is fully charged?—S. B. F., Fort Wayne, Ind.

Answers.

No. 107.—Thermal Cutout for Flatirons.—I understand that there have been patented several thermal cutouts for use with electric flatirons to open the circuit automatically when a certain temperature is reached and thus prevent burning out of the heating element. Has any iron on the market been equipped with a device of this kind that is both reliable and foolproof, so that it can be entrusted to the ordinary household servant?—W. L., Beloit, Wis.

To my knowledge there has been no thermal device put on the market that would successfully regulate the tempera-

ture of an iron. There have been a great many different thermals tried out for this purpose. In some local cases where alternating current has been used they have been successful, but the same appliance could not be adopted for general use because the first time it was used on direct current the outdrawn points would separate, making the device worthless. The only advantage in having an automatic regulator would be to save the operator from having to regulate the temperature of the iron by turning off and on the current. There is little danger of burning out the heating element in any of the standard irons on the market now, providing the iron is used on a voltage within range of 15 or 20 per cent of the voltage for which the heating element is constructed. The ordinary working temperature of an iron is from 500 to 600 degrees Fahrenheit. It is not at all uncommon for a good quality electric iron to be placed on current continuously for months at a time, thereby maintaining the entire bottom of the iron at a dull red heat. The resistance material used in all high-grade iron nowadays has a melting point of 2,700 degrees Fahrenheit and you will see from the above that, unless the heating element is electrically defective, there is very little opportunity for the same to burn out.—J. R. R., Chicago, Ill.

No. 118.—Aluminum Plating.— Can aluminum be electroplated on brass objects just like nickel? If so, what solution is used and what strength of current is suitable?—N. P., Fort Worth, Tex.

The essential features of a new system of electroplating with aluminum are as follows: A solution of ammonia alum in warm water is prepared containing 20 per cent of alum. To this is added a solution containing about the same quantity of pearlash (potassium carbonate) and a little ammonium carbonate. The mixture results in effervescence, and in the forming of a precipitate. The latter is filtered off and well washed with water. A second solution of alum, containing 16 per cent of alum, and 8 per cent of pure potassium cyanide, is now prepared warm and poured over the precipitate previously obtained, the mixture being then boiled for 30 minutes in a closed iron vessel, jacketed to insure uniformity of heating. The proportions suitable in the above solutions are as follows: First alum solution—ammonia alum, 2 kilograms; warm water, 10 kilograms. Pearlash solution—pearlash, 2 kilograms; warm water, 10 kilograms; ammonium carbonate, 8 to 10 grams. Second solution—ammonia alum, 4 kilograms; warm water, 25 kilograms; potassium cyanide, 2 kilograms. At this stage about 20 kilograms of water are added and about 2 kilograms more of potassium cyanide, and the whole is kept boiling for about a quarter of an hour. The liquid is then filtered from the precipitate and is now ready for use in the electrolytic bath. The anodes are perforated or slotted plates of aluminum, arranged so that they can be conveniently raised or lowered. The cathodes receive the deposit. The anodes and cathodes are connected respectively to the terminals of a battery or of a dynamo, and the current is thus transmitted through the bath, which is kept throughout the operation at a temperature of about 80 to 150 degrees Fahrenheit. By attaching to the aluminum anode pieces of other metals, e. g., gold and silver, nickel, copper, etc., the tint of the deposited metal can be somewhat varied. When the deposit presents a gray tint, it is brightened by dipping the plated article in a solution of caustic soda, which has also the effect of impeding oxidation. I would advise against using a voltage in excess of 1.5 volts. This being an aqueous solution and as water is decomposed at 1.5 volts, trouble from liberated hydrogen may occur if a greater voltage is used.—W. R. T., Buffalo, N. Y.

There have been many formulas for aluminum plating published, but as far as I know none is successful because the aluminum is not *deposited* but merely *held* in mechanical union with the ion of some impurity plated to the cathode surface. At any rate I believe there is no way of plating the metal from aqueous solutions.—W. M. P., Seattle, Wash.

No. 121.—Combined Lock and Burglar Alarm.—Has a burglar alarm operated by the unlocking of the bolt of a lock ever been placed on the market? I have in mind a device mounted in the door jamb which would close the alarm circuit as soon as the bolt was withdrawn.—A C. N., Mount Vernon, O.

I have never seen nor heard of a burglar spring made specially to operate in the manner mentioned, but it would be a very easy matter to install a small telescopic door spring (such as the No. 1541 made by the Manhattan Electric Supply Company, of New York City) in the keeper of the door jamb so that the lock bolt would operate it; this is an open-circuit spring one and seven-eighths inches long and has only one lug to attach it to the wood, therefore being so small it would escape detection and would go in any ordinary keeper hole. Burglar locks are only used so that an authorized person can enter a burglar-alarmed building without setting off the alarm, the proper key acting as a closed switch to keep the circuit intact. The wiring for the bolt alarm could be arranged either open or closed circuit to accord with present installation, if any.—B. R. B., Philadelphia, Pa.

No. 122.—Iron Pipe Underground Conduit.—Is iron pipe still used in this country to any extent as an underground duct for electric cables?—S. E., Colorado Springs, Colo.

Iron pipe which makes an excellent duct for inside work, is not used to any extent for underground conduits except under exceptional conditions, on account of its high cost. It has the advantage that it may be bent so as to avoid obstacles presented by other underground structures. In other cases, a cheaper competitor, such as cement-lined pipe, fiber conduit, vitrified-clay duct, or monolithic-concrete conduit, is to be preferred. I believe that the vitrified-clay duct is the most popular at the present time.—F. D. K., Schenectady, N. Y.

Iron pipe as underground conduit in this locality is a thing of the past. Terra-cotta ducts in sections with the raceways for the cables arranged in tiers of three are the general practice. Some companies use the square external and round internal creosote-treated wood tubing in some installations, the ends of this wood duct being fitted together. Both of these types are laid on a concrete bed in the trench. In some cases, however, iron pipe is laid for laterals from the street main through the wall of the building, in cases of electric light or power service.—B. R. B., Philadelphia, Pa.

Banquet of Patent Law Association.

Nothing is sufficiently wrong with the patent system of the United States to justify its being made completely over as contemplated in the Oldfield bill now before Congress, according to the opinion of Commissioner of Patents Edward B. Moore, as expressed at the banquet of the Patent Law Association, held in Washington, D. C., on the night of January 31.

Mr. Moore declared that with a new building, additional officials and larger salaries for some of the officials, the patent system of the United States will be adequate to every requisition made upon it, and that there should be higher fees for patents charged than are now charged in order to help obtain the proposed new building, additional officials and higher salaries.

Mr. Moore's views received the endorsement of other speakers at the banquet, among them Representatives R. J Bulkly and Martin A. Morrison, members of the Committee on Patents of the House of Representatives.

Toledo Automobile Show.

At the Automobile Show held at Toledo, O., during the week ending January 25 there was a good display of electric cars. The Ohio Electric Car Company, Toledo, had an excellent display, including one model which may be driven from either the front or rear seat.

Electric starters for gasoline machines were given much attention, and it was noticeable that farmers laid particular stress upon this element of the equipment. Many of the cars displayed were fitted with electric heaters.

Convention of Western Association of Electrical Inspectors.

Eighth Annual Meeting, St. Louis, Mo., January 28, 29 and 30.

From the standpoint of things accomplished, the convention of the Western Association of Electrical Inspectors, which was held at St. Louis last week, was an unusually successful meeting throughout the three days. From 10 o'clock each morning until about 6 o'clock in the afternoon, with but little more than an hour's intermission for luncheon, the time was filled with the presentation and discussion of papers and committee reports that could not but prove highly helpful and instructive to the members of the association and, for the most part, to the visitors in attendance as well. There was an abundance of entertainment, too, but this was provided at such hours that it did not interfere with the regular order of the technical part of the program.

The meeting was opened Tuesday morning with brief talks by Walter Rapp and T. D. Beardsley, who made announcements concerning a banquet to be given Tuesday night by the St. Louis League of Electrical Interests complimentary to those attending the convention, and a rejuvenation and banquet arranged by the Jovians for Wednesday night. Then followed an address by W. J. Canada, the president of the Western Association, who spoke of the beginnings and growth of electrical inspection and told something of the development and prestige of the National Electrical Code. He said that the Code was now the standard specification for electrical work for sixty millions of people or more.

To the roll call, which followed, 40 members of the association responded. During the following sessions the attendance grew until there was a total registration of 80 members and guests

The report of the Executive Committee, read by William S. Boyd, the secretary and treasurer of the association, showed that 20 new members had been received during the year just past, and that the total membership is now 172.

On motion of James Bennett, of Montreal, the rule requiring that members of the association be residents of the United States was suspended, and C. M. Tate, of Camden, was admitted to membership.

A nominating committee, consisting of Waldemar Michaelsen, of Omaha; James S. Mahan, of Chicago, and C. L. Reasoner, of Colorado Springs, was appointed by the chair. A motion by W. H. Moore, of La Grange, Ill., to have the proceedings of the last annual meeting printed was carried.

The afternoon session Tuesday opened with an address by F. A. Driscoll, of Chicago, who spoke on the manufacture and use of electrical porcelain. Mr. Driscoll's paper showed that he was not only familiar with the present manufacture and use of porcelain, but that he had carefully studied developments in the manufacture of this material from the time commercial porcelain was first obtained until the present. In the discussion of this paper H. E. Bloomer, of Milwaukee; B. H. Glover, of Chicago; Emil Anderson, of Minneapolis, and G. W. See, of Minneapolis, participated. The association requested Mr. Driscoll to have his paper printed and supply copies to be mailed to every member, which he agreed to do.

Relation of Transmission Lines to Telephone and Telegraph Lines.

The paper by Mr. Driscoll was followed by one on the above subject by H. B. Gear, of Chicago. Mr. Gear said that the possibility of damage to the equipment of telephone and telegraph companies in case of a cross with high-tension lines, as well as the risk of the life of operators, renders very important the proper safeguarding of transmission lines. Various interests, such as telephone companies, telegraph companies and railroad companies operating telegraph systems have proceeded independently to establish specifications which to them seemed necessary to safeguard their equipment at points where they were crossed by transmission lines. Some of these have sought to secure protection by the use of wire cradles or networks suspended in such a way as to catch any broken wires. Some of the railroads have even required the use of a bridge of quite substantial construction to carry the conductors across their right of way. The cradle construction has been found objectionable in that the poles were overloaded by the extra weight, and the cradle was quite likely to cause trouble almost as serious as that which it was designed to prevent. The bridge construction, while so strong that it could not fall down, is prohibitively expensive for any except very important lines. The power companies in some cases have refused to provide any protection claiming that their franchise rights entitle them to as free use of a highway as was accorded by the franchises of the telephone companies, and that the telephone companies should provide protection at their own expense if they considered it necessary. A situation of this class was brought to an issue during the past year between the American Telephone & Telegraph Company and one of the divisions of the Illinois Traction Company, at Lincoln, Ill. In this case a 33,000-volt line was brought along a street where it stood directly above a distributing line of the local Bell company, some of the poles being so placed that the Bell company's wires rubbed against them. The telephone company having first established its line on its right of way instigated legal proceedings to enjoin the railway company from operating its transmission line. The outcome of this litigation established a precedent which requires the power company to provide the necessary protective equipmen to secure the safety of the telephone service.

Mr. Gear explained that the National Electric Light Association held a series of conferences during the year 1911, with representatives of the American Railway Engineering and Maintenance of Right of Way Association, the American Institute of Electrical Engineers, the American Electric Railway Association and the Association of Railway Telegraph Superintendents, with a view to establishing a standard specification for crossings which would be acceptable to these various associations and which could be used by all light, power and electric railway companies in making their crossings. These specifications for the most part were adopted at the conventions of these various associations held during 1911 and 1912. There are still some paragraphs which are under discussion and which will, no doubt, be agreed upon during the coming year. The specifications are based upon the general principle that it is more practical to increase the factor of safety of the line itself than to provide auxiliary protective equipment, which decreases rather than increases the factor of safety. The crossing is to be made so strong that it will not come down under the most severe weather conditions which are experienced in any part of the United States. The specifications cover all crossings over railroads and all crossings over telephone

lines where the voltage is over 5,000. The transmission wires are to be carried across without turns and at such an elevation as to be above the telephone or telegraph wires. No cradles or bridges are to be used. The crossarms however, are to be covered on the top with a metallic strip, which is securely grounded, so that the line will be put out of service by the automatic devices at the power house in case there should be a break in the conductor.

Clearances of not less than 30 feet above the rail and 8 feet above telephone and telegraph lines are to be maintained. The conductors are to be of stranded copper not smaller than No. 4 B. & S. gauge, or not smaller than No. 1 if of aluminum. There are to be no joints in the crossing span. The poles are head-guyed each way in the span each side of the crossing to prevent wires sagging down in the crossing span in case they should break in any of the spans adjoining the crossing. The strength of the conductor must be sufficient to carry a load of half an inch of sleet under a wind pressure of eight pounds per square foot. The poles or towers must be of sufficient strength to support the strain when a part of the wires are broken.

Mr. Gear's paper was discussed by W. J. Canada, G. W. See, H. B. Long, C. J. Stewart, M. E. Cheney, L. A. Barley, W. H. Moore, H. E. Bloomer, Emil Anderson, William S. Boyd, V. H. Tousley, O. M. Frykman and R. L. Daniels. Answering questions by Mr. See and Mr. Tousley, Mr. Gear said that weatherproof insulation on 2,300-volt lines was not without value in cases of temporary contact, but that it sometimes induced a false sense of security on the part of workmen. Mr. Long considered it unfortunate that in his territory in Tennessee extra high-tension transmission lines were being brought into and carried through many of the smaller towns. He argued that these lines ought to be carried around the towns. Mr. Frykman's suggestion that printed copies of the specifications which Mr. Gear had discussed be secured for all the members of the association was endorsed and arrangements made to secure the necessary number of copies.

Electrical Laboratory Test Problems.

A paper on this subject by B. H. Glover, of the Underwriters' Laboratories, Chicago, dealt at some length with the matter of insuring the general use of only such electrical fittings and materials as are entirely safe from both the standpoint of life and that of property. The speaker emphasized especially the importance of following up materials and fittings in service to see how they stand up under operating conditions. In this the Laboratories needed the co-operation of the electrical inspectors of the country.

Discussing Mr. Glover's paper, Mr. Barley said that he could not see why the National Code should specify one thickness of metal for cabinets and another for junction boxes. He wanted to know why thinner metal was allowed in the case of the junction box than for the cabinet. Speaking along the same line, V. H. Tousley pointed out that the thickness of fixture canopies is not prescribed at all, and suggested that it was not consistent practice to specify the thickness of the cover of an outlet box and not that of fixture canopies. O. M. Frykman brought up the matter of fuse protection for fixture wires and flexible cords, and this introduced a long discussion of fuse protection for branch circuits. The disposition of the meeting seemed to be to favor permitting the use of 10-ampere fuses on branch circuits rather than to reduce the fuse size below 6 amperes.

The 660-Watt Branch Circuit and Its Relation to Mazda Lamps.

W. H. Blood, Jr., of Boston the well-known insurance expert for the National Electric Light Association, was unable to be present in response to an invitation to read a paper on the relation of the branch circuit to the larger incandescent lighting units now coming into such general use; but he submitted a letter on the subject, which was read by Mr. Boyd, the secretary of the association.

Mr. Blood said that there seemed to be considerable ambiguity with reference to the 660-watt rule, and that the rule itself was further complicated by the requirement that branch circuits on 125 volts shall be fused with six-ampere fuses. He believed it a mistake, at the present time, to limit a circuit to carrying 660 watts, in view of the fact that there are so many heating devices which carry approximately this amount of power, and that these are going to be used on branch circuits. It is going to be an unnecessary hardship to require the running of a separate circuit for a percolator or a teakettle or a small flatiron. In the same way, he believed that it is a mistake to limit branch circuits to 10 or 12 outlets. He did not think there was any more danger with 20 outlets than there is with 10, and was quite sure that the records would not show that there was any special menace due to increase in the number of outlets. On the other hand, he felt that there ought to be some way of limiting the circuits from the customer's standpoint; it would be a mistake to put 20 lamps on a circuit, for this would mean, in many small installations, that all of the lights would be on one circuit, and if a fuse blew, everything in the house would be out.

He said that he had found upon investigation that there are comparatively few six-ampere fuses used. He had the records of two companies, one of which last year put out no six-ampere fuses and did distribute 5,000 ten-ampere fuses; the other company put out 1,200 six-ampere fuses and 32,000 ten-ampere fuses. His own feeling was that it would be wise to limit branch circuits to carrying 1,000 watts and provide that these circuits be protected by ten-ampere fuses. He also recommended that, as far as possible, No. 12 wire be substituted for No. 14, for with No. 14 wire the question of "drop" enters materially.

He thought it a good suggestion that two types of plugs be used, one to be called a "household plug," and to be furnished with all portable electric heaters taking less than 1,000 watts; all other heaters taking over 1,000 watts to be furnished with a larger plug, and the heater to be distinctly marked, "Not suitable for use on lighting circuits," and these large heaters to be installed on separate circuits with their own switches and pilot lights.

W. J. Canada did not favor Mr. Blood's suggestion of permitting 1,000 watts on a branch lighting circuit, but was not especially opposed to the use of 10-ampere fuses on such circuits. The letter was also discussed by Messrs. Gear, Driscoll and R. L. Daniels. Mr. Gear thought Mr. Blood had not given the question of cost due consideration in suggesting the use of No. 12 instead of No. 14 wire. He thought the suggestion as to 10-ampere fuses was a good one, however.

Second Day of Convention.

The Wednesday morning session of the convention opened with a paper by W. J. Canada, the president of the association, whose subject was "The Present Status of Grounded Secondaries." This paper is published in an abridged form elsewhere in this issue.

O. M. Frykman proposed a vote of thanks to President Canada, which was carried, as was also his motion to make the paper a part of the published proceedings of the convention. After further discussion, in which Thomas Barnum, F. R. Daniels, A. P. Good, F. L. Daniels and others took part, a motion was passed placing the Western Association of Electrical Inspectors on record as endorsing the rule with reference to the grounding of

secondaries, which the Electrical Committee of National Fire Protection Association formulated at its meeting in Boston last spring.

The afternoon session on Wednesday, was devoted to the discussion of problems arising in electrical inspection. The question of adopting a table showing the minimum sizes of wires for induction-motor leads was referred to the Code Committee of the association, as was the starting devices for all induction motors of above five horsepower in capacity. In the discussion of these subjects James Bennett, M. E. Cheney, Ben W. Clark, V. H. Tousley, Thomas E. Barnum, L. A. Barley, Waldemar Michaelson, W. R. Russell, Fred Johnson, O. M. Frykman and W. H. Moore took part, and the greater part of the discussion emphasized the advantages which might be gained by incorporating these requirements in the National Electrical Code.

On the subject of the use of armored cable in concealed work, Waldemar Michaelson, Harry H. Hornsby, Ben W. Clark, L. E. Good and V. H. Tousley spoke, the substance of the discussion being that any troubles that had been encountered in the use of this material in concealed wiring had resulted from extreme carelessness on the part of wiremen.

The question of permitting the use of motor-driven moving-picture machines, came up for consideration, and, on motion of James Bennett, it was decided to invite H. S. Wynkoop, of New York, to read a paper on the subject at the next convention. Mr. Bennett explained that Mr. Wynkoop was in a position to speak with unusual authority concerning the fire hazard of such appliances. Motor drive was discussed at some length by W. B. Hubbell, of Cincinnati, A. J. Pruvot, of Sioux City, and Messrs. Tousley and Bloomer. The danger of lack of proper attention on the part of the operator was emphasized.

A motion was passed to recommend to the Code Committee of the association that it suggest to the Electrical Committee of the National Fire Protection Association, the advisability of incorporation in the National Electrical Code, a rule requiring the draining of conduits in reinforced concrete buildings. This motion, which was made by F. G. Waldenfels, of Chicago, was vigorously opposed by James Bennett, H. E. Bloomer and Waldemar Michaelson, who insisted that it was seldom practicable to install conduits in buildings of this type so that they would drain. H. B. Long, of Nashville, Tenn., said that draining was not an effective remedy for condensation in conduits, anyway. Where condensation was had, sufficient water to rot the insulation of the wires would cling to the walls of the pipes in spite of all that could be done in the way of inducing it to flow out of openings provided for the purpose.

Report of Committees.

The closing day of the convention was largely taken up with the reports of various committees previously appointed to consider certain improvements considered desirable in connection with electric wiring and the use of electrical appliances.

During the discussion of a recommendation of a committee on theater wiring that open-link fuses should not be installed on assembly-hall switchboards, William F. Hall, of the engineering department of the General Electric Company, was requested to favor the meeting with some account of his own experiences as a specialist in theater switchboard design and operation. He spoke especially of the advantages to be gained from the use of boards having no live parts on the front of the board, and of the great importance of employing only fuses that can be replaced without a screw driver or other tool of a kind liable to cause a short-circuit, when in the hands of an excited or awkward electrician. He also discribed a new type of switch which his company is manufacturing for use of the so-called dead-front switchboard for theaters. Mr. Hall brought out a point which was very favorably received when, a little later on in the meeting, he asked the support of the inspectors for those manufacturers who try to keep on the market only such materials and fittings as have been approved by the Underwriters' Laboratories. Thomas E. Barnum announced too, that his company, the Cutler-Hammer Manufacturing Company, was adhering strictly to the practice of submitting new apparatus to the Laboratories with ll possible promptness.

The report of the Committee on Public Safety dealt at some length with the grounding of secondaries in alternating-current distribution systems, and was accompanied with suggestions concerning the restriction of the use, or abuse, of flexible cord, and elimination of brass-shell sockets from places where their use is dangerous on account of moisture or grounded surfaces. Perhaps the most important recommendation of the Committee was that the use of conduit on armoured cable be extended to all places where by any possibility open wiring can be mechanically disturbed or its insulation injured.

The Committee on Laws and Ordinances suggested minor changes in a number of Code rules, and especially favored the discontinuance of the use of wooden molding in electric wiring. During the discussion of this matter, in which Fred Adams and C. J. Sutter, of St. Louis, W. B. Hubbell and others participated, there was much favorable comment concerning metal molding. The chair called upon C. W. Abbott, of the National Metal Molding Company, who spoke concerning the installation of this material.

The Committee on Show Windows and Display Lighting directed attention to the necessity of installing only flush receptacles of the waterproof type in the floors of show windows, and their report included other such matters as the prevention of the use of key sockets in windows, the elimination of paper shades for lamps, the prohibition of the use of cotton batting in windows, etc.

Group at Meeting of Western Association of Electrical Inspectors—Left Half.

At the conclusion of these reports a letter from Frank J. Burch, of Chicago, concerning the installation and operation of induction motors was read, Mr. Burch being the chairman of the committee on this subject. This report covered the matters of starting currents and motor leads in detail.

Program of Entertainment.

Tuesday night, January 28, those attending the convention of electrical inspectors were the guests of the St. Louis League of Electrical Interests at a banquet and vaudeville show, this being the annual meeting and dinner of the League. There were speeches by A. C. Einstein, of St. Louis, who was elected president of the league during the meeting, and by Sam Hobson, of Chicago; Waldemar Michaelsen, of Omaha, and William S. Boyd, of Chicago. Mr. Hobson spoke especially of the popularity of W. N. Matthews, of St. Louis, among the members of the League and suggested him as the candidate for Reigning Jupiter of the Sons of Jove.

The meeting was characterized by a spirit of good fellowship and high-class entertainment.

On Wednesday night there was a rejuvenation of the Jovians, at which 82 members were received into the order. Past Jupiter A. E. Morgan of Dallas, Tex., was present and spoke in glowing tribute of the benefits of Jovianism. At the dinner which followed there were speeches by W. A. Layman, W. N. Matthews, Sam Hobson, F. D. Beardslee and Statesman Richards. During the speeches the candidacy of W. N. Matthews for Reigning Jupiter was proposed and was enthusiastically received. Following the dinner there was a vaudeville entertainment, which was greatly enjoyed.

It was announced that there would be another Rejuvenation in May and that there were 30 candidates already on the waiting list.

Members of the Western Association of Electrical Inspectors who remained in St. Louis during Friday following the convention were taken on a trip of inspection to the electrical establishments and other points of interest in the city.

Other Convention Notes.

During one of the sessions of the convention the secretary read a letter from James E. Cole, of Boston, a member of the Executive Committee of the National Association of Electrical Inspectors. Mr. Cole had been invited to attend the convention, but, on account of business engagements, was unable to do so.

Before adjournment the Association presented William S. Boyd, its secretary and treasurer, with an expensive traveling bag, a handsome toilet set and a portfolio in appreciation of his services for the organization. The speech of presentation was made by Waldeman Michaelson and was characterized by appropriateness and a happy vein of humor. There was also a rising vote of thanks to St. Louis League of Electrical Interests, and others who had acted as the hosts of the visitors, for the splendid manner in which the visitors had been entertained. Special mention was made of the good work of James H. Fenton, the chairman of the Committee on Entertainment, and Mrs. Fenton was presented with a beautiful box of flowers in appreciation of the kindness of herself and husband.

The next meeting of the Association will be held in Cincinnati, January 27, 1914.

The officers elected for the current year are: James Bennett, of Montreal, president; Ben W. Clark, of Detroit, first vice-president; W. A. Davis, of Spokane, second vice-president, and William S. Boyd, of Chicago, secretary and treasurer. The Executive Committee consists of H. M. Maxwell, G. W. See, W. J. Canada, S. J. Conrad, H. M. Davis and W. B. Hubbell.

Manufacturers Represented.

The electrical manufacturers having exhibits at the convention and their representatives included the following:

Wagner Electric Manufacturing Company, Fred Johnson; Century Electric Company, W. R. Russell; H. W. Johns-Manville Company, Walter Rapp; Economy Fuse Company, E. B. Mallory and J. B. Griffith; Crouse-Hinds Company, F. F. Skeel; Cutler-Hammer Manufacturing Company, Thomas E. Barnum; Sprague Electric Works of the General Electric Company, Harry H. Hornsby; Beck Elevator Signal Company, Arthur Beck; Frank Adam Electric Company, Fred Adam and W. P. Holcombe; W. Douglas Wooley; National Metal Molding Company, C. W. Abbott; Safety-Armorite Conduit Company, Victor F. Gates. Most of these manufacturers had exhibits of special interest to the electric inspectors.

Group at Meeting of Western Association of Electrical Inspectors—Right Half.

Examination for Irrigation Engineer.

The United States Civil Service Commission has announced an open competitive examination for assistant irrigation engineer to be held on February 26 and 27 at the usual places. From the register of eligibles appointments will be made in the office of experiment stations, Department of Agriculture, at salaries ranging from $1,200 to $1,600 a year. The examination will include drawing, structural drawing, technical, scientific and practical questions, and a thesis upon one of two subjects submitted at the examination. In addition, one-quarter of the total credits will be given for education, training and previous experience.

PRIME MOVERS.[1]

By S. Z. de Ferranti.

In dealing with the subject of prime movers it is interesting to consider how steam came to be the working fluid of the first engine.

In steam we have a power the whole of which is available for doing useful work. The power required for pumping the water into the boiler, which is the negative work of the cycle, is so small that it is almost negligible. Whatever the power given by the steam in the cylinder, less the friction of the engine is available for doing useful work. It is therefore clear that however inefficient the engine may be it will go round and do some useful work.

When you consider the state of mechanical construction in the days of Newcomen and even in Watt's time it is evident why steam became the first motive fluid. Besides these reasons it was possible to use steam on account of being able to do so at low temperatures and pressures. The early steam engines had pressures very little above the atmosphere and had not therefore to contend with much higher temperatures than that of boiling water. Moreover the low pressures were less difficult to deal with in the early days of very imperfect mechanism.

The first prime movers or engines in which the heat of the fuel was converted into work were therefore steam engines and may be classed under the heading of prime movers of low negative work. Although the Newcomen engine was in use before the days of Watt, it was exceedingly uneconomical and his great work was the improvement of the efficiency of this engine to such an extent that it became useful and economical for general service. The greater part of the work done since his time has been in the same direction, viz., in a continual endeavor to improve the efficiency of conversion of the heat in the fuel into mechanical work.

With this object in view, higher steam pressures involving higher temperatures were introduced, and compound engines, and later on triple expansion engines, were developed to more effectively utilize the higher ranges of steam pressure. James Watt considered the question of superheating the steam, but with the appliances at his disposal, working under these conditions was quite out of the question. Later on, however, superheating was introduced and largely applied with a view to using a higher temperature range, but with the difficulties arising from unsuitable materials and want of knowledge and design the system was not practically economical, and after an extensive trial was abandoned for many years.

James Watt, besides inventing and developing the modern steam engine, had turned his attention to the question of applying steam to motive purposes on what he called a steam wheel, so getting direct rotary motion. The work of Sir Charles Parsons in the invention and development of the rotary principle to the production of motive power by means of steam must ever be remembered as a great advance in the development of prime movers. The turbine, notwithstanding its very low efficiency as first constructed, was gradually improved until high mechanical efficiencies of conversion have been reached. Especially is the turbine valuable in the production of large powers and in taking advantage of high degrees of vacuum.

Before, however, the modern turbine had been developed, another idea had been pursued with a view to simplifying the process of power generation and at the same time getting a higher economy. Years ago an engine was invented and built by Lenoir in which a charge of air and gas was sucked into the cylinder at atmospheric pressure and exploded. The piston speed in this engine was low, the ratio of expansion was low and needless to say the economy was very poor. Still it was a step in the direction of higher economy, insomuch as by this system a higher temperature of working fluid was obtainable. Later on Otto and Langen invented a gas engine in which a flying piston was used, driven upwards by the explosion of a mixture of gas and air introduced into the cylinder without compression. The pressure of the atmosphere aided by the weight of the piston pressed the piston downwards and through an ingenious clutch and a rack and pinion gave rotary motion to the flywheel. This gas engine was an improvement on the previous one as the pressure of explosion was higher and the ratio of expansion was greater. Both these engines, although of the explosion type, came under the heading of "low negative work" as the explosive charge was simply sucked into their cylinders and was not compressed before firing.

The great move forward which was next made was that of compressing the charge of explosive mixture before firing and so getting a high maximum temperature, a good ratio of expansion and consequently much improved economy. Engines of this type belong to a class of prime movers with "high negative work." In this form of engine the positive work of the explosion has to have deducted from it, not only the friction of the engine but also the amount of work required to compress the charge, which constitutes the negative work of the cycle. There is a further deduction, viz., that of the friction of the engine or of a separate pump whilst doing negative work. These deductions are very serious and would render this class of motor useless were it not for the high mechanical efficiency of the parts used for carrying out the cycle.

In the gas engine the negative work is high but not so high as to form a serious difficulty.

In the more economical Diesel engine, in which very high pressures are used so as to get a high enough temperature to burn the oil as sprayed into the cylinder and give a high ratio of expansion, the negative work is a much more serious difficulty. So serious was it in fact in the first Diesel engine that it required more power to overcome the friction and negative work than the engine was capable of giving, so that it would not even drive itself and much less was it capable of doing any useful work. The cycle of the engine was therefore modified in the direction of making it less perfect theoretically and so enabling the engine to become the success which you know it to be today.

If the engines of high negative work had been invented in the days of James Watt they could never have been made workable, as the materials available at the time would not have stood the temperature, and mechanical knowledge and construction was not sufficiently advanced to enable that high degree of mechanical efficiency to be reached which is necessary with engines of this class.

The development of the internal-combustion engine of high negative work which was started before the birth of the modern steam turbine has been vigorously pushed on over a period of years concurrently with the work done on the turbine and now both are competing for premier place in furnishing the world's power. The turbine, though less economical in actual fuel consumption, has many great advantages and for large powers today unassailable. For small powers the turbine is naturally uneconomical.

From a careful and dispassionate consideration of the subject it seems, according to present knowledge, to be clear that for small powers the internal-combustion reciprocating engine is in every way the best. At the other end of the scale the turbine is the only means of filling our requirements today. In between these two extremes there is a doubtful dividing line where either form of engine may best serve the purpose according to the conditions of the particular case.

As the turbine gets bigger so is it easier to construct and it also becomes more economical. As the gas or oil engine gets bigger I need hardly remind you how the natural difficulties increase. On the other hand, as the turbine is reduced in power its economy falls off badly and

1 Portion of the James Watt Anniversary lecture delivered at Greenock, Scotland, January 16.

and it is difficult to make of a satisfactory design. The internal-combustion engine or the contrary becomes a most satisfactory and economical machine in small sizes, as witness the thousands of gas engines in use all over the world and the beautiful engines working on the Diesel cycle which are small enough to avoid water-cooling of the pistons.

I think that this division of the means of power production by large and small units between the rotary and reciprocating machine is almost a natural law and those who seek to evade it must either invent some new principle or court endless trouble, expense and failure.

Today, with a complete disregard of the above principles, the advocates of the Diesel engine for marine propulsion are spending vast sums of money on its development, but even this usually all powerful force may not prove enough to make a wrong principle right. The daily press and also our well informed technical journals tell us of all the wonderful successes of large oil engines in Germany and elsewhere, but I can assure you that few people have any conception of the failures and breakdowns which have occurred and which are repeatedly occurring with the big experimental engines that have been constructed. In Germany, especially, where so much has been done in this direction, they carefully avoid informing the foreigner on these points.

The subject of prime movers is one in which I have always been most interested, and in following it my constant aim has been to increase the amount of work that can be usefully obtained from a given amount of fuel. It is, of course, well known that the higher the temperature of the working fluid the higher is the economy that can be obtained. High temperatures have, however, proved very difficult to work with and as an instance of this the low working temperatures of turbines for marine propulsion may be pointed out. Seeing, however, that the difficulties were mechanical and that great advantage could be derived if these troubles were overcome, I commenced experimenting some years ago and have now after many failures and the expenditure of much money and time produced a turbine which at the highest temperatures and with great and rapid variations of temperature is quite free from mechanical troubles. Indeed I believe that this turbine is perhaps the strongest from a mechanical point of view that has yet been produced. Moreover, contrary to what might have been expected with a high-temperature machine, it runs with certainty with a blade-end clearance that is so small that it is almost negligible from the point of view of leakage loss, and the fear of the possibility of stripping appears to have been effectively removed.

In this turbine I superheat the steam initially and after the first expansion and whilst it is still superheated, resuperheat it before it does its work in the second stage of the turbine. After this it is exhausted in a superheated condition through a regenerator to the condenser. The whole of the blading is electrically welded so as to avoid the straining due to calking at the high temperatures that are reached and also the loosening that occurs due to the same cause. The blading is formed of mild steel with a thin coating of pure sheet-nickel electrically welded on to the surface. The blading is most accurately finished to shape by a process of step-by-step pressing under very heavy pressure.

The blading, the sections of which are very exact, is welded in position with the accuracy of the automatic machine that is used for the purpose and every opportunity is thus given for realizing the best results. Although the turbine is of the reaction type no balance dummy is used. The whole of the end load is taken on a specially constructed thrust, thus saving steam leakage.

The steam is worked as a gas at high temperature throughout the turbine and this coupled with the many improvements above referred to has given very good results.

The 5,000-horsepower machine, which has now been running for some time, when tested at a load of two-thirds full power, has given a shaft horsepower on seven pounds of steam, which if supplied by an oil-fired boiler superheater system of 85 per cent efficiency, which has already been exceeded in central-station practice, would consume less than 0.625 pounds of oil per shaft horsepower.

From many tests already made, it appears that when this turbine is run at full load under favorable conditions it will take less than six pounds of steam per shaft horsepower and that the system under the conditions named will have a thermal efficiency of over 24 per cent, corresponding to an oil consumption of about 0.55 pounds of oil per shaft horsepower. The tests are being proceeded with, but as the turbine is run continuously in supplying power to a large works with a constantly varying load, it is not easy to do what is necessary to enable tests to be carried out. So far as I can see this system when applied on a large scale will be capable of giving an overall thermal efficiency of 29 per cent.

When the advantages of the turbine system in the way of lightness, simplicity and certainty are borne in mind, and when they are compared with what is known of the complicated reciprocating oil engines now being introduced for marine purposes, the possibilities of the new system of high-temperature gas steam turbine become of great interest.

Steam as a practical motive power so brilliantly invented and applied by James Watt has had a long and most useful application in our civilization, but it cannot be looked upon as the eventual solution of the power problem even for large powers. It can, however, be immensely improved in efficiency.

With a high-temperature steam turbine of large size generating electricity to supply power for all purposes on land, one has the advantage of a machine of the highest efficiency which is not limited to oil for its fuel. It is probable that as improvements are made the whole of the coal used for firing these large units will be gasified and the by-products recovered. When this result is brought about we shall have not only an ample and cheap supply of fertilizer for the land, but also a great quantity of the tar oils which will form a suitable means of firing for naval purposes, and will relieve us from the necessity of purchasing fuel oil abroad and the risk and cost which this process involves. We will also have an ample supply of benzol for all our small motor requirements. This, I think, is the solution of the fuel problem for these motors rather than in the production of alcohol on a large scale from the land as has lately been advocated. When we are supplied with ample quantities of fertilizer at a low cost, both the land and the labor involved for the production of alcohol will be much better occupied in other ways. After all, the great problem for this country is to so utilize the coal that we produce that we make it fill our every requirement. This, as I have shown you, will be done in the not very distant future.

The electric motor which gives its power in a rotary form and which is supplied from very large power stations is displacing all forms of small engine. It is therefore probable that in the future small prime movers will only be required to propel cars and boats and that all stationary motors will be electric. The electric motor with its one running part so easily and conveniently applied to all purposes is a good illustration of the desirability and even the necessity of the rotary principle of engine. Reciprocating forms of engine will no doubt be used for a long time, but they can only be regarded as makeshifts and so soon as an equally efficient machine for any particular purpose is developed it must surely displace the reciprocating motor. No doubt as knowledge increases, many forms of prime mover will be developed of higher and higher economy. It is difficult to predict the form of the prime mover of the future, but in search of the highest economy and with the limitations of temperature imposed by known materials one is inclined to look to electricity, converting the energy of the fuel at low temperatures and giving its power in rotary form, as the most likely eventual solution.

Philadelphia Section Activities.

The regular January meeting of the Philadelphia Electric Company Section of the National Electric Light Association was held in the Franklin Institute on Monday evening, January 20. Preceding the meeting 52 members and visitors enjoyed themselves at a unique dinner, a usual feature before the Philadelphia meetings. This dinner was held at the New Bingham Hotel. Some of the members furnished music and a general good spirit prevailed, which also tended to enliven the regular meeting following.

From 7:30 to 8:00 p. m. at the Franklin Institute, under the direction of James T. Maxwell, chairman of the Assembly Room and Exhibition Committee, two very interesting demonstrations were given. Mr. Anderson of the Rumsey Electric Company demonstrated the bell-ringing transformer, and Mr. Bailey of the General Electric Company demonstrated three types of ozonators.

Clarence Renshaw, speaker of the evening, dealt with the topic, "Modern Electric Railway Operation." He traced the history of electric power from the time of the horse car to the modern high-class railway equipment. The details of control, many problems arising therefrom and their method of solution were gone into and very clearly elucidated. Mr. Renshaw called attention to the modern method of purchasing power from existing sources, thus minimizing investment and specializing the work, as being one of the fundamental features of modern electric-railway operation. He stated that the same fundamental economic reasons were responsible for the combined ownership of certain small companies. He called attention to the fact that only 75 per cent of the power generated, reaches the car, the remaining 25 per cent representing losses in lines and other apparatus. In the case of the usual city car only about 30 per cent of the power reaching the car is actually expended in drawing the car; 35 per cent of the amount reaching the car is about equally divided in heating the motors and the starting resistances and about 35 per cent is expended in the brakeshoes; this condition being due to the numerous stops and the average city conditions.

The use of the interpole motor was mentioned as a vital step in modern electric-railway equipment. This motor improves commutation, permits satisfactory field control, reduces starting-resistance losses, permits additional speed, gives a wider range of running speeds, prevents the unnecessary burning of brushes, etc.

Many points were brought out regarding the special features of modern electric-railway control. The present control employed was developed by Mr. Renshaw and he showed very clearly the many factors considered in the development of this apparatus and the advantages obtained. Mr. Renshaw called attention to the fact that in shifting work it was possible to replace two steam locomotives with one electric, this being possible on account of the necessity of overhauling the fires and the attention necessary to steam locomotives.

A very interesting discussion followed the delivery of Mr. Renshaw's lecture. W. C. L. Elgin discussed the paper and expressed his appreciation of the excellent manner in which Mr. Renshaw dealt with the subject and moved a vote of thanks, which was unanimously carried. The discussion was also participated in by Messrs. Calvert, Cheyney, Duus, Penrose, Albrecht, Taylor, Coe, Russell and others.

The regular January meeting of the Meter Department Branch was held January 3, Frederick Strattner, vice-president, presiding. Four very interesting and instructive papers were read by Messrs. Cordner, Ploetz, Duus and Donley of the Testing Section. The subject of the evening was "Meter-Testing Methods." It was clearly shown that while there are many methods employed in the testing of watt-hour meters, yet each is closely allied with the other and has some particular application. The Philadelphia Electric Company has spared no expense in developing methods by which their men may be brought to the highest point of efficiency as meter testers.

A. R. Cordner spoke of large-capacity alternating-current meter testing, including meters from 50 to 300 amperes capacity.

William Ploetz covered the subject of high-tension switchboard-meter testing. Attention was called to the type, capacity, characteristics, etc., of the meters employed.

H. G. Duus covered the subject of large-capacity direct-current meters and spoke concerning the many difficulties encountered in testing this type of meter and the kind of equipment used.

W. H. Donley spoke concerning the company method of testing. He traced each step in the development of this method and showed the careful research that had been necesary in the solving of such problems as the elimination of an assistant meter tester, determination of the proper rotating standards, ratios, constants, etc., development of suitable load device, efficient method of carrying tools, minimizing the units necessary for the tester to carry and the development of many features incident to this method of testing. Mr. Donley gave a demonstration of the use of this method and of the tools and equipment employed. Between each of the talks, lantern slides were shown of the tools, equipment and methods shown as previously explained. The discussion was interesting and spirited and of a kind that makes the Meter Department meetings a success.

George Ross Green took part in the discussion in his usual interesting manner, as did also W. H. Bartlett.

B. Frank Day, chairman of the Section, called attention to the importance of Section work. Messrs. White, Taylor, Currier and Seaman also participated in the discussion.

H. K. Hammond, former employee of the Meter Department, now with the Metropolitan Electric Company, of Reading, Pa., was present and participated in the discussion.

The Good and Welfare Committee, under the leadership of F. L. Ruschmann, supplied oyster sandwiches and coffee and the usual metermens' fellowship prevailed. The attendance, 91, was very good for a branch of the Section.

The January meeting of the Accounting Department Branch was held on January 14. Arnold F. Mayers read a very exhaustive paper on the clerical work involved in reading meters, making tests, attending to complaints, preparing bills, etc. In addition to being very ably written, Mr. Mayers's paper showed a most intimate knowledge of the work and his discourse was very instructive to the bookkeepers in the Accounting Department, inasmuch as the work in that department dovetails naturally with the work of the Meter Department. There was a good attendance at the meeting and the discussion which followed the presentation of the paper was both animated and interesting.

The January meeting of the Commercial Branch was held on January 27, Walter T. Dyre, chairman, presiding.

William Foster, of the Aerial Line Department, delivered a very interesting paper on "Service Estimates and Construction." Many vital factors entering into the consideration of a service estimate were brought out by the speaker. Attention was called to the advantage of using a large transformer and secondary distribution system in preference to a transformer for each consumer, with reduction in cost and better regulation. It was mentioned that the cost of copper in a distrbuting system of this character increases somewhat, depending upon the size of the transformer and the districts covered. A saving in transformer losses results. Several very interesting cases met with in actual practice were recited. The discussion was participated in by G. Ross Green, J. D. Israel, A. R. Granger, J. W. Derrick, Washington Devereux, R. L. Lloyd, and Messrs. Donley, Coe, Hulley, Lochart, Gilfillan, Silbert, Dyre, Finley, Kerford and Goodwin.

Steps have been taken toward forming an additional branch to cover the technical or engineering deparements other than the Meter Department or Installation Bureau. Thomas Sproule, past Section chairman, has been elected temporary chairman, and A. L. Atmore temporary secretary.

BOOK REVIEWS.

"The A B C of the Differential Calculus." By William Dyson Wansbrought. Third edition. New York: D. Van Nostrand Company. Cloth. 148 pages (5x7¼ inches), illustrated. Supplied by the Electrical Review Publishing Company for $1.50.

This excellent little work fills a long felt want, as it affords an easy approach and gives satisfaction to the interested layman who has no patience to follow the usual dogmatic treatises on differential calculus. It is written in the first person. The diction is simple and the method assuring.

The author appreciates the viewpoint of the student and if he had done no greater service for mathematics he has at least unshrouded the venerated derivative of its deplorable mystery. He might have made the work more serviceable by introducing real applications of practical problems in the chapters preceding "Maximo and Minima." The graphic methods used in teaching calculus would have greater weight were they introduced in the earlier chapters. It is to be regretted that a book which is so exceptionally free from errors should make use of the obsolete term "infinitely small" and fall into the misstatements on "limits" in chapter viii, and accentuate these by mixing increments and differentials in Figs. 6 and 8.

The book should have a wide circle of friends among technical men as well as among the constantly increasing number of candidates for teaching positions in secondary schools, who wish to acquire the knowledge of the principles of differential calculus with a minimum of effort and time and a maximum of understanding.

E. H. Koch, Jr.

"Studies in Light Production." By R. A. Houstoun. London: Electrician Printing & Publishing Company, Limited. Imitation Leather, 115 pages (5½x8½ inches), illustrated. Supplied by the Electrical Review Publishing Company for $2.00.

This book will interest both practical and technical men. It is a valuable addition to technical literature, not only on account of the valuable data pertaining to common illuminants, but because of the many references which are found throughout the concisely written text. The data on energy-measuring instruments and the description of experimental methods will be of great assistance to those who do not have ready access to scientific journals or to those who have not the time to develop instruments and methods of their own.

While without question the work is valuable to the technical world, the scientist will sometimes disagree with Mr. Houston. For instance, the author assumes that Koenig's luminosity curve obtained for a normal eye is that for an average eye. There is, however, considerable difference between the luminosity curves obtained for the so-called normal eye and the average eye. The author also places undue emphasis on measurements of radiant efficiency. Owing to the diversity in the spectral character of our modern light sources and the indefinite extent of the visible spectrum, measurements of radiant efficiency are of little value, especially if not accompanied with measurements of luminous efficiency.

The author treats the more common illuminants in a clear and concise manner, adding references which comprise a brief though valuable bibliography of the important literature on the subject which has been published during the last 12 years. An interesting chapter is devoted to a discussion of the possible trend of research in light production, with the conclusion that higher efficiency must be expected along the lines of selective radiation.

The book contains a valuable collection of data on the phenomena of light production written in a clear and interesting manner and will prove of value to both the scientist and engineer.

M. Luckiesh.

Electric Vehicles and Accessories at Chicago Automobile Show.

The thirteenth annual show of the National Association of Automobile Manufacturers, occupying the entire floor space of the Coliseum, Annex, Wilson Building and First Regiment Armory, was held in Chicago, February 1 to 15. The first week was devoted to passenger vehicles and accessories and the second week, February 10 to 15, will be given over exclusively to commercial vehicles and accessories.

The exhibit of passenger cars and accessories conducted the first week was credited as being the largest ever held. This is also true of the exhibit of electric vehicles and accessories, the displays not only being more numerous than at any previous show, but more comprehensive in extent. The increasing popularity of the electric, particularly with professional and business men, has created the demand for a greater variety of models than was previously manufactured. At least one roadster or runabout type is shown by the leading manufacturers, thus fulfilling the demand for a car for those accustomed to the appearance and design of the gasoline machine.

Aside from the exhibits of 15 manufacturers of electric vehicles, however, the show is of significance to the electrical industry on account of the important position occupied by electric apparatus in the gasoline-car industry. Electric starting and light equipments for automobiles have made enormous advances during the past year and practically every car manufacturer of the 102 represented, either provides these equipments or is in a position to furnish them on demand.

Among the exhibits the following are of interest from the electrical standpoint:

Anderson Electric Car Company, Detroit. This company exhibited three broughams and a five-passenger limousine.

Argo Electric Vehicle Company, Saginaw, Mich., showed three broughams and a chassis to demonstate the operation of the transmission.

Baker Motor Vehicle Company, Cleveland, exhibited a Victoria, colonial brougham, extension brougham and an extension coupe.

Borland-Grannis Company, Chicago, had on exhibition an outside-drive coupe, two broughams and a new type roadster.

Broc Electric Vehicle Company, Cleveland, had on exhibition one four-passenger coupe and two five-passenger French model broughams.

Buffalo Electric Vehicle Company, Buffalo, N. Y., exhibited three new model broughams.

Century Electric Car Company, Detroit, had on exhibition three four-passenger coupes.

Chicago Electric Motor Car Company, Chicago, exhibited its models 131 and 132, five-passenger broughams.

Columbus Buggy Company, Columbus, Ohio, exhibited a new model five-passenger brougham and two four-passenger coupes.

R. C. Hupp Corporation, Detroit, had on exhibition two five-passenger Hupp-Yeats broughams.

Ohio Electric Car Company, Toledo, Ohio, had on exhibition two four-passenger broughams, a coupe and a stripped chassis.

Rauch & Lang Carriage Company, Cleveland, Ohio, exhibited a new model town car, three broughams and a coupe; also a stripped chassis.

Standard Electric Carriage Company, Jackson, Mich., exhibited three four-passenger broughams.

Woods Motor Vehicle Company, Chicago, had on exhibition several improved designs of its five-passenger broughams and four-passenger coupes.

Waverley Company, Indianapolis, Ind., had on exhibition its new limousine model 100, which uses separate Pullman chairs for each of the occupants. Several broughams and a roadster were also shown.

Among the accessories the following electrical companies were represented: Connecticut Telephone & Electric Company, Dean Electric Company, Detroit Electric Appliance Company, Joseph Dixon Crucible Company, Esterline Company, Electric Auto-Light Company, Electric Products Company, Heinze Electric Company, International-Acheson Graphite Company, Kokomo Electric Company, North East Electric Company, Remy Electric Company, Splitdorf Electrical Company, Vesta Accumulator Company and Westinghouse Electric & Manufacturing Company.

Storage batteries were exhibited by the Edison Storage Company, Electric Storage Battery Company, Gould Storage Battery Company, U. S. Light & Heating Company and the Willard Storage Battery Company.

New Electrical and Mechanical Appliances

Transformer for Outdoor Installation.

Almost since the dawn of the electric era small lighting transformers of comparatively low potential have been installed out of doors, and they have satisfactorily withstood the service, their superior design and construction making them proof against the fury of the elements. But no effort was made at the same time to develop a line of high-tension power transformers for outdoor service, owing to the demands for power being confined to centers of population where the power stations and substations were located. Recently, however, owing to the fact that it is often desirable to tap a high-tension line where the load is not sufficiently great to justify building a sub-

Lighting Transformer, Type H, 2,200 Volts.

station, high-tension transformers of all capacities and for any commercial voltage have been designed for outdoor service. An impetus has been given to this development by the phenomenal demand for electric power made by prospective consumers located in the country along high-tension transmission lines, who realize the advantages of electricity for both power and light but who do not require enough power to justify the expense of a substation.

The installation of the apparatus out of doors obviates the necessity of constructing new buildings or enlarging the existing station to provide room for the new apparatus and so may greatly reduce the cost of expansion. Yet, it is probable that very few persons outside of those connected with the design or sale of power transformers realize the rapid progress that has been made in the use of transformers in outdoor service and the excellent records for reliability that those installed have made.

The familiar pole-type transformers, used on city distribution circuits having a potential of from 2,300 to 4,000 volts, are comparatively simple to design for outdoor service on account of the relatively low voltage. Standard transformers, in capacities of from 1 to 100 kilovolt-amperes are readily obtainable for this class of service and all

Self-Cooled Transformer, Type H, 33,000 Volts.

sizes embody practically the same construction with the exception of tanks.

The core for these transformers, as built by the General Electric Company, is made up of four magnetic circuits of equal reluctance placed in multiple. Each circuit consists of four legs arranged to form a rectangle, one of these legs being built up of two widths of punchings in such a manner as to form a tenon on the outside of the leg. When the four circuits are assembled with these four legs together, the latter interlock to form a central leg upon which the winding is placed. The core, when viewed end on, has the form of a cross. This construction brings the oil in contact with an unusually large part of the surface of the core and coils, so that undue heating of the core and coils is not possible under normal load or reasonable overloads.

As the result of the use of a thick mica shield between the primary and

Power Transformer, Type H, 66,000 Volts.

secondary windings, the highest degree of safety, which is the most important characteristic of a transformer, is obtained. This mica shield is designed to withstand a potential of from 15,000 to 20,000 volts and is practically indestructible when used on circuits having voltages around 2,500.

An abundance of oil ducts and channels, through which the circulation of oil is maintained, results in uniform temperature throughout the transformer and eliminates the detrimental effects of unequal expansion in the coils with consequent rubbing and injury to the insulation.

All live terminals are located below the surface of the oil to prevent surges or lightning discharges from arcing and short-circuiting the coils, or grounding to the tank.

The impedances of transformers of the same size vary but slightly, so that when such transformers are operated in multiple, each takes its proper share of the load.

The use of a special alloyed steel in the cores of these transformers has brought the core loss down to a minimum value with a consequent low loss when the transformer is slightly loaded and, as this steel is non-aging, there will be no increase in the core loss after an indefinite period of operation.

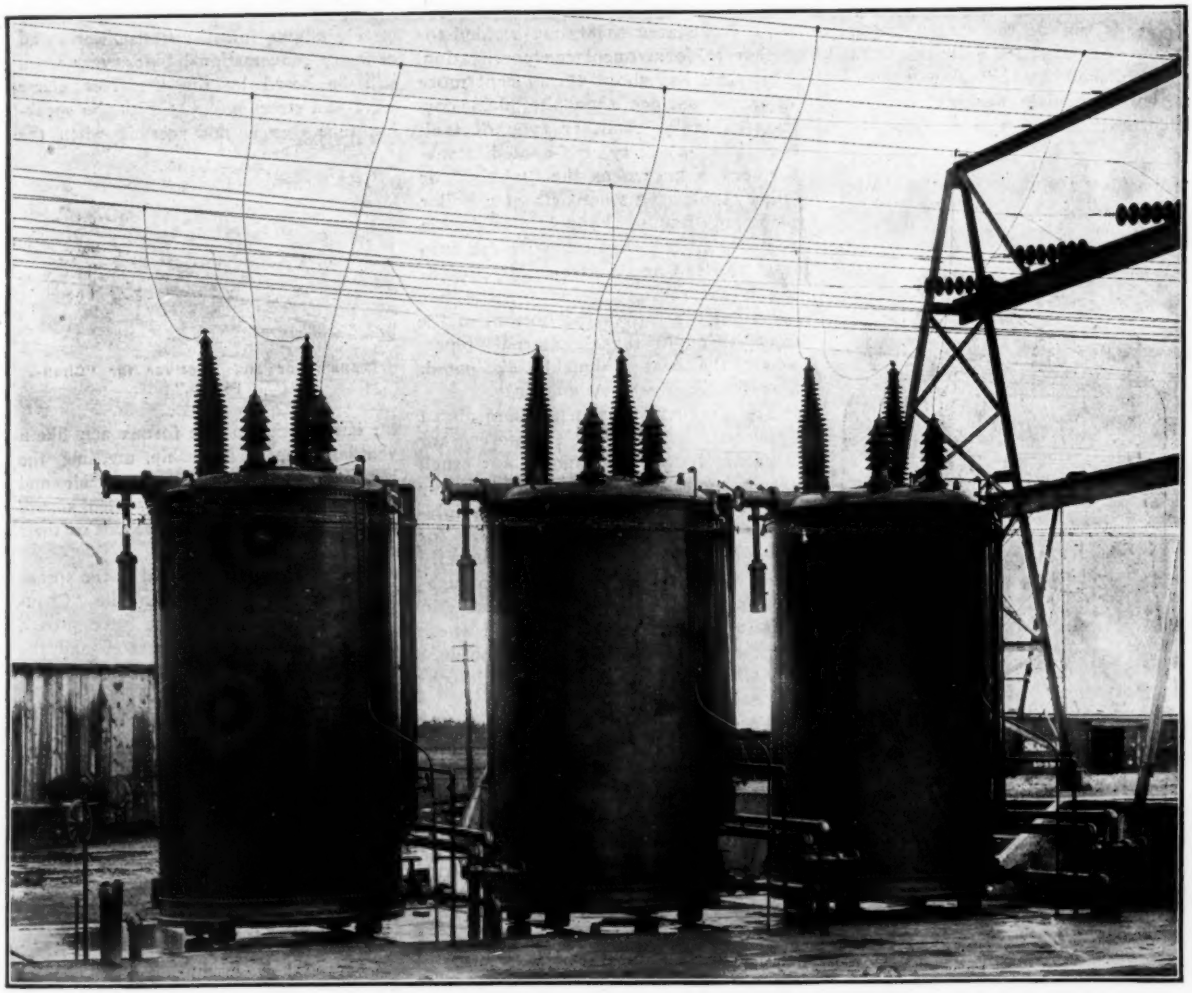
Transformers below 25 kilovolt-amperes capacity are placed in smooth cast-iron tanks. Above this size the tanks are corrugated in order to obtain sufficient surface for radiation of the heat generated within the transformer due to the losses. The largest of these sizes, if made of cast iron, would be too heavy and bulky for suspending on poles, so that they are made of corrugated sheet steel. For operating on poles in the open and on the walls of buildings under the eaves, the tanks that contain these transformers must be weatherproof. The cast-iron covers are, therefore, provided with overhanging edges and the joint between cover and tank is sealed by a gasket effectively preventing the entrance of moisture and dust. The cover is securely fastened to the tank by two eyebolts which also serve as a means of lifting the transformer. With eyebolts, the cover can readily be removed from the tank without the use of a wrench.

The primary bushings have thick walls and the portion which extends beyond the transformer is hemispherical in shape so as to give a long creeping distance from the primary conductor to the frame. The rounded surface is not fractured or chipped, as it would be if the bushings had sharp corners.

Power transformers of 100 to 500 kilovolt-amperes for distributing potentials (2,300 to 6,000) and all transformers above 6,000 volts up to 500 kilovolt-amperes employ a different type of construction than the distributing transformers above described. In these transformers, the straight two-legged core type construction is employed. The core consists of two vertical legs connected together at the top and bottom by yokes, thus formin a rectangle.

Cylindrical coils and insulation cylinders are placed concentrically over the two vertical legs of the core, the high-voltage winding being outside the low-voltage winding and separated therefrom by oil ducts and the abovementioned insulating cylinders.

Power transformers for all voltages may be self-cooled or water-cooled. In self-cooled transformers, the heat arising from the losses in the transformer is dissipated into the surrounding air by providing a tank with sufficient external radiating surface to limit the temperature inside the transformer to



Water-Cooled Transformers in Service on 110,000 Volts.

a safe value. The tanks for these transformers are made from sheets of steel, corrugated under great pressure and electrically welded together. A base and rim are cast directly to the corrugation, the joint between them being an actual weld. This forms a rigid one-piece tank which, when supplied with a suitable cover and gasket, is readily adapted for outdoor operation.

The main difficulty, however, in designing high-voltage transformers for outdoor use is encountered in bringing the leads out of the tank. In transformers below 17,500 volts this is easily accomplished by bringing them out through porcelain bushings set in, or underneath, the rim around the top of the tank. For potentials above 17,500 volts this method is unsafe, so the leads are brought straight out through openings in the cover and protected from the weather by a porcelain covering, built up of several petticoats.

Self-Cooled Transformer for 110,000 Volts.

In water-cooled transformers, the heat generated by the losses in the transformer is artificially extracted from the oil by circulating cold water through a seamless coil of pipe placed in the upper part of the tank and submerged in the oil. The expensive corrugated tanks for radiating the heat are, therefore, unnecessary, so a plain steel-plate tank is provided. Transformers in these tanks are suitable for outdoor operation when equipped with porcelain-petticoat leads brought out through metal bushing holders.

Transformers having a capacity greater than 500 kilovolt-amperes are built of the shell type. Self-cooled, shell-type transformers are not built in capacities much above 3,000 kilovolt-amperes because of the large and expensive tank construction necessary to obtain sufficient radiating surface. The extra radiating surface necessary for self-cooled transformers above 750 kilovolt-amperes is obtained by compounding the corrugation, i. e., two plain corrugated sheets are welded together to form one large corrugation. This tank has about 65 per cent more radiating surface than the plain corrugated tank. Another type of tank for large capacity self-cooled transformers is known as the "tubular" or "pipe" tank. This consists of a boiler plate tank having the ends of a double row of vertical steel tubes welded into it at the top and bottom, this providing a natural circulation for the hot oil from the top to the bottom of the tank through these external pipes, where the heat is quickly dissipated. These tanks are very efficient.

The majority of transformers above 1,000 or 1,500 kilovolt-amperes are water-cooled. The tanks for such transformers are made from heavy boiler plate, being round for single-phase transformers and elliptical for three-phase units. They are perfectly plain and smooth, having no corrugation or pipes, which are unnecessary in this type of transformer. All these various tanks are designed for outdoor use when furnished with a suitable cover, gasket and leads.

Three large water-cooled transformers, rated at 2,750 kilovolt-amperes each, have recently been designed for outdoor operation on a 110,000-volt circuit. These are in successful operation at the present time. Some 1,000 kilovolt-ampere-self-cooled transformers in tubular tanks are also in successful operation outdoors on a 110,000-volt circuit.

A Telephone Set for Limousines.

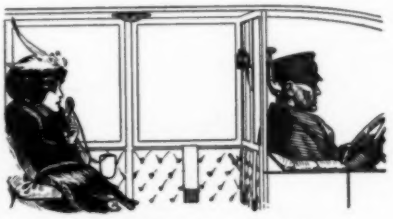
At the automobile show recently held in Madison Square Garden, New York, a feature attracting more than the ordinary amount of attention was the Western Electric "Chau-Phone," a telephone set designed for use in limousine cars. The set may be installed in old as well as new machines and is intended to replace the speaking tube now in almost universal use for transmitting instructions from the occupant of the car to the chauffeur.

The set consists of a hand transmitter, shaped somewhat like the familiar magnifying glass, a loud-speaking, megaphone-shaped receiver, a flexible transmitter cord and wire. To operate the telephone, the regular car batteries may be used, as a voltage of only from six to eight volts is required.

The transmitter contains a gravity switch which closes automatically when the instrument is held with the handle down. When not in use, the transmitter is placed, with its handle up, in a pocket in the upholstery of the car. This prevents the wasting of battery current when the set is not being used for talking. The receiver may be placed, either for right or left-hand drive, directly at the chauffeur's ear and the design is such that by merely talking into the transmitter in an ordinary conversational tone, every word will be heard by the chauffeur above wind and street noises. With the speaking tube this is not possible when the car is in motion, as the former acts like a ventilator on a steamship, muffling the sound so that it is barely audible and often inaudible. The tubes also absorb a great deal of sound on account of their elastic wall structure.

Transmitter and Receiver for "Chau-Phone."

All the objections inherent in the speaking tube are overcome in the "Chau-Phone." Trials in service have proven the tone volume to be greater and the articulation to be better. The construction of the receiver also seems to cause the pitch of the speaker's voice to be raised, making it heard more easily. The receiver is weatherproofed and is furnished in dull black, nickel or polished brass.



"Chau-Phone" In Service.

Many visitors to the automobile show stated that the use of the "Chau-Phone" would no longer make it necessary, on account of the uselessness of the speaking tube, for the occupant of the car to open the door of the car to shout directions at the chauffeur with danger of injury from passing vehicles.

Pulmotors have been installed by the Edison Electric Illuminating Company of Boston in all its power plants.

Mazda Weather-Proof Lamp Lacquer.

The Electric Sales Company of Detroit, Mich., has recently produced a new lamp-coloring which it calls Mazda Weather-Proof Lamp Lacquer. This new lacquer is obtainable in six colors: canary, amber, white, red, blue and green. The colors are remarkably brilliant and any number of tints may be produced by blending the different standard colors.

The chief difficulty experienced with lamp lacquers in the past has been the checking and cracking resulting from extreme temperatures, together with the inability to withstand severe storms. The Electric Sales Company positively guarantees Mazda Weather-Proof Lamp Lacquer to outlast the useful life of the lamp itself. Furthermore, it guarantees that the colors will not fade.

The lamp manufacturers are enthusiastic in their recommendations of Mazda Weatherproof Lamp Lacquer as their tests have demonstrated that this new coloring in no way affects the life of the lamp itself. The ordinary lacquers in general use confine the heat of the lamp within the bulb in a manner that is detrimental to the life of the filament. The new lamp lacquer permits this natural heat to radiate practically as fast as from a clear bulb and, having the same coefficient of expansion as the bulb itself, it will not crack or check with every change of temperature.

Sign manufacturers have long sought a product that would enable them to assure their clients of displays in delicate lamp colorings that will remain uniformly brilliant. Sign manufacturers who have attempted to use natural colored bulbs realized what an expensive and unsatisfactory proposition this is. Owing to the variance in the glass it is almost impossible for the manufacturers to make close selections that will enable them to guarantee lamps for series or series-multiple operation, whereas, the clear bulbs can be selected with the assurance of absolute uniformity of amperage. Unless low-voltage tungsten lamps are operated in connection with a transformer, it is absolutely essential that close selection be made or "high lights" and early burn-outs will result.

Additional Telephone Equipment for the Chicago, Rock Island & Pacific Railway.

The Chicago, Rock Island & Pacific Railway Company recently placed an order with the Western Electric Company for apparatus to be used in extending its telephone train-dispatching and message circuits. The successful operation of the present lines and the economy resulting therefrom have been the incentive for the extension. Two new circuits are to be equipped. One is intended for train-dispatching service and will be installed between Des Moines, Iowa and Trenton, Mo. The other will be used as a short-haul talking and message circuit between Davenport, Iowa and Rock Island, Ill., including the yard district in the latter territory. The length of the line in the first-named case is approximately 110 miles while the latter is about 5 miles. The new installation will consist of two complete dispatcher's equipments, 21 selector sets, miscellaneous equipment and line material.

Appleton Entrance Unilets.

The Appleton Electric Company, 212 North Jefferson Street, Chicago, Ill., has added a set of service entrance boxes to

Three-Wire Service Entrance Unilet.

its extensive line of Unilet conduit fittings. As shown in the accompanying illustrations these new Unilets possess the distinctive feature of a removable cover; this is a great convenience in drawing in the wires, since they can be given a straight pull. The cover is well flanged and fits tightly over the rest of the box when fastened in place. Covers and porcelain face plates are made for

Entrance Unilet With Cover Raised.

any number of wires from one to eight, inclusive, and the entire Unilet is made in sizes suitable for one-half-inch to four-inch conduits. The finish is either black enamel or sherardized, as specified.

Extension of Underwriters' Laboratories.

Underwriters' Laboratories, Incorporated, has secured 10,000 square feet of additional land adjoining its holdings on East Ohio Street, Chicago, and plans to extend its present testing-station buildings to provide additional space for hydraulic and chemical laboratories and offices. This follows the recent completion of a special building for tests of structural methods and materials and will give the institution a total ground area of 26,600 square feet, a total floor area in buildings of 45,000 square feet and a yard space of 9,000 square feet.

The year 1912 showed an increase of 50 per cent over 1911 in the volume of business handled. When the present extension is completed the plant will represent an expenditure of $175,000, this amount having been contributed by the stock fire-insurance companies.

Greenwood Sign News.

Individuality, which is the keynote of all electric signs constructed by the Greenwood Advertising Company, Knoxville, Tenn., is also strikingly apparent in the new sign bulletin which has recently been issued by the company. As stated in the bulletin, it has been the policy of the company to give individual attention to every sign, regardless of size, recommendations for designs being based on an analytical study of the article to be advertised and the audience to be reached. To show to what extent this policy has been adhered to, numerous examples of Greenwood signs, recently installed in different parts of the country, are reproduced in the bulletin. A wide variety of conventional and spectacular designs are shown advertising the products of local and national advertisers.

Complete information is also given in the bulletin relative to the Lansdell luminous-letter signs, patent rights of which have been purchased by the Greenwood company; also relative to color effects, "Klok" monograms, flashing mechanisms, etc. General information of interest to prospective sign users is also given.

Coincident with the issuance of the new bulletin, the Greenwood Advertising Company announces the opening of its new factory at Los Angeles, Cal. This plant will be of the same size as the Knoxville works and both will have a local inspection by the National Board of Fire Underwriters, with the label system.

Lockwood, Greene & Company Conference.

The second annual conference of Lockwood, Greene & Company, architects and engineers for industrial plants, 60 Federal Street, Boston, was held in Boston on January 13 to 16. The 113 engineers of the firm, including the managers and engineers of the Chicago and Atlanta offices were present. The main idea of these conferences is to discuss the ways and means of improving the efficiency of this large engineering organization and also to acquaint the men with each other, so that the firm as a whole may better serve its clients.

The conference opened with a reception at the new offices of the firm in the First National Bank Building. On two of the days many papers were presented by department heads and officials and these were open to discussion.

THE COOPER HEWITT QUARTZ LAMP.

By Joseph C. Pole.

The quartz lamp represents an additional commercial development of the principles involved in the mercury-vapor lamp invented by Peter Cooper Hewitt. In principle, the difference between the standard Cooper Hewitt lamp and the quartz lamp is only the greatly increased pressure of the luminous vapor in the latter. The standard Cooper Hewitt lamp is not ordinarily run at a higher density than a pressure equal to about one-eighth-inch mercury column, while the pressure in an operating quartz lamp may be that of the atmosphere or higher with the result that the temperature in the luminous vapor is extremely high. With the high vapor pressure the potential per inch of the luminous column is very great, thus necessitating the use of a correspondingly short tube.

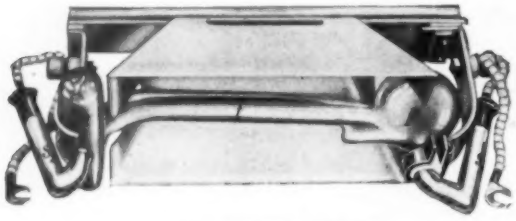


Fig. 1.—Quartz Burner.

The ordinary Cooper Hewitt lamp and the Cooper Hewitt quartz lamp represent, from the practical point of view, two contrasting types, in spite of having been built upon the same physical foundations. The one possesses great area of luminous surface with a consequent small intrinsic brilliancy and so low a temperature that it may be considered near the "cold light" of the scientist; the other with a radiant of small surface gives a very concentrated and intense light and works at very high internal temperatures.

Besides the discontinuous spectrum characteristic of mercury, the quartz lamp, owing to the high temperature, emits also a luminous spectrum, like incandescent bodies, and it is due to this circumstance that the light of the quartz lamp contains, besides the predominant yellow, green, blue and violet lines of the mercury spectrum, red and orange rays, there being more of the latter the higher the vapor temperature.

A mercury container for the direct-current Cooper Hewitt quartz lamp is shown in Fig. 1. Its main part is the tube t carrying the luminous vapor terminating on one (the positive) end and in an enlargement p and on the other (negative) end in the lateral tube n. Mercury in each enlargement forms the two electrodes, which receive the electric current by small upright U tubes s_1 and s_2. Rods of slightly conic shape of a special alloy are ground into the wall of these upright tubes, and the joints are covered with mercury which again is closed in by a layer of a suitable compound to prevent access of air and prevent the mercury from being spilled or vaporized.

When a cold quartz lamp is started, it requires a rather high current, owing to the small drop of potential at the low pressure, and the whole cross section of the luminous tubes of the burner is filled with the pale bluish-green light. But presently, as the lamp warms up, the appearance changes; the light recedes from the walls and, with increasing vapor pressure, becomes concentrated in the center of the tube in a thin dazzling path; the current, at first steadily dropping, becomes stationary, and the appearance of the light assumes a whiter color with a visible gain of red and orange rays as the lamp attains its temperature of operation. The change of the lamp current and the voltage of a 220-volt, 3.5-ampere Cooper Hewitt quartz burner with reference to the time after starting is shown in Fig. 2.

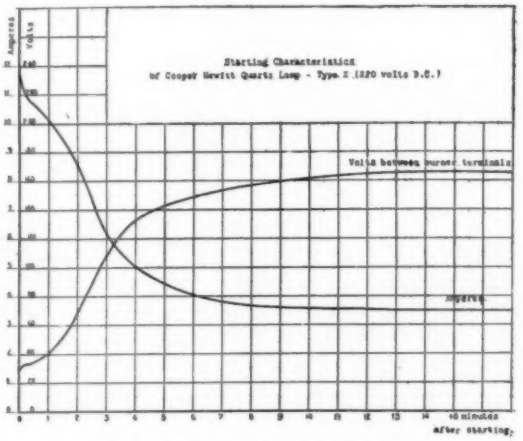


Fig. 2.—Starting Characteristics.

The essential parts of a commercial quartz-lamp outfit are the following: A series resistance for regulating the burner voltage and making the lamp adaptable to a wider range of supply voltage; a series inductance for steading the arc; a glass globe to prevent too rapid a dissipation of heat from the burner, and to absorb the ultra-violet rays; and, if the lamp is to be automatic, a starting device.

The ultra-violet rays in which the mercury arc is especially rich, and which are readily transmitted by quartz, may be considered injurious to the eyes for a short distance. The most actinic of these rays, i. e., those with the shortest wave-length, are absorbed by passing through a few inches of air; but all are completely absorbed by common glass, so that a surrounding globe of clear glass affords absolute protection from these rays. The bactericidal and physiological effect of the ultra-violet rays is too well known to be dwelt upon here but has no effect when the light passes through a glass globe. When a quartz lamp is used for the purpose of the generation and utilization of ultra-violet rays, no glass should be inserted in the path and the lamp should be placed as close as possible to the exposed object.

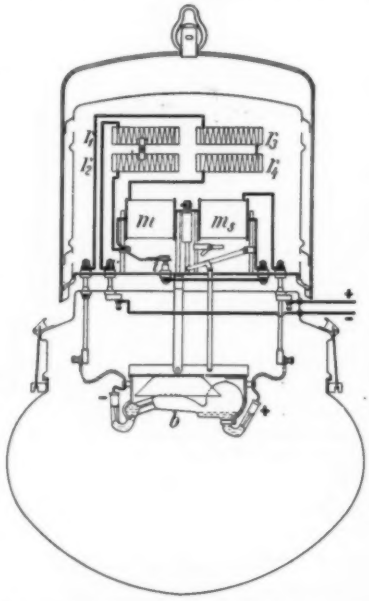


Fig. 3.—Wiring Diagram of Type Z Lamp.

Two types of Cooper Hewitt quartz lamps are here described. These are for multiple connection on direct-current lines; one for 110 and the other for 220 volts. From alternating-current supply circuits they may be operated through the medium of the Cooper Hewitt rectifier.

The 110-volt, 4-ampere quartz lamp has a quartz burner similar to that already described and shown in Fig. 1. The burner is securely held in an aluminum support to which a white-enameled reflector is fastened. The holder with its T-shaped backbone is pivoted in a support and by means of a tilting lever is linked to the movable iron armature of an electromagnet and, in order to avoid sudden shocks to the movable parts, a dash-pot is connected to the armature.

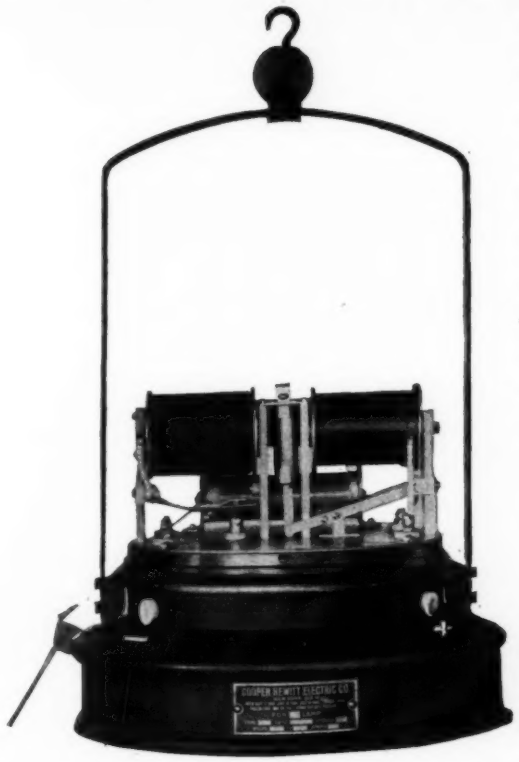


Fig. 4.—Enlarged View of Auxiliary Mechanism for Type Z Lamp.

A small movable permanent magnet is suspended above the armature; it locks automatically the tilting device when the polarity at the lamp terminals is reversed and so protects the burner against being ruined by a reversal of polarity. Two small resistance coils, one being equipped with a fuse wire and a sliding contact for regulation, complete the auxiliary apparatus. The ventilated canopy, the insulated hanger and the ring holding the glass globe are very similar to those used with arc lamps.

Burner, magnet and resistance are all connected in series and the burner in its position of rest is inclined, so that the two mercury electrodes are in contact. When the line switch is turned on the short-circuit current magnetizes the solenoid and the movable armature (and the burner) is turned on its pivots until the contact between the two mercury electrodes breaks and the arc starts. As long as the lamp is under current the burner is held in its running position by the magnet.

The fuse wire will withstand the heavy current during the starting period of the lamp, but will, within one minute, be fused by the additional heat generated in the first resistance spool, if for any reason the mechanism should stick and the short-circuited burner continue to receive current.

The 220-volt, 3.5-ampere quartz lamp, shown in Figs. 3, 4 and 5, has a burner and a general appearance very similar to the above described, but its mechanism is different. The running position of the quartz burner, *b*, Fig. 3, is identical with its position of rest. For starting, the two electrodes are brought in contact by the movable armature of a shunt magnet *ms*. At the moment of the short-circuit between the electrodes the series induction coil *m*, operating an automatic cutout *i*, is energized and interrupts the circuit of the shunt magnet, so that the burner drops back to its original position and the arc is lighted. This auxiliary is also provided with an automatic locking device for protection against reverse of polarity. Four series resistance coils r_1, r_2, r_3, r_4, the first two of which are equipped with the sliding contact, complete the mechanism.

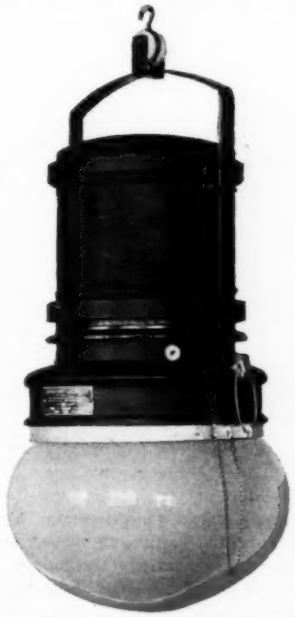


Fig. 5.—Type Z Quartz Lamp Complete.

These quartz lamps are made by the Cooper Hewitt Electric Company, Hoboken, N. J.

Federal Prismatic Signs.

A new type of electric sign has been placed on the market by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago. The sign is lighted entirely from the interior and has its face or faces made entirely of glass letter units. These are made of solid plate glass so that the background is a glossy black surface from which the letters themselves are pressed in clear glass with longitudinal magnifying prisms or raised ribs that intensify the light and at the same time confine it to the exact outline of the letter. This gives the letters remarkable distinctness of outline and brilliancy and makes them easily legible from a great distance. The effect is very pleasing both by night and by day.

New Federal Prismatic Sign.

Th new sign also produces considerable economy in operating cost because each letter requires only a single lamp in double-faced signs. Eight 25-watt tungsten lamps serve to illuminate brilliantly both sides of a four-letter sign. The framework of the sign is of steel and is well painted with a suitable border molding design. The frame is hinged to give easy access to the interior for cleaning or lamp renewals. The letters themselves are 14 inches high and the letter units 19.5 inches. The surface of these units being entirely made of smooth glass, it is easy to keep clean and polished, thus giving the brilliancy so much desired.

One of the new signs can be seen in the heart of Chicago's main shopping district, being hung before the entrance of the Mentor Cafeteria at the northeast corner of Monroe and State Streets.

Girod Electric Furnace on Pacific Coast.

The Washington Iron Works, Seattle, Wash., manufacturer of mill, mining and marine machinery, which makes a specialty of logging and hoisting engines, is installing a three-ton Girod electric furnace in its new foundry, together with complete steel-foundry equipment for the manufacture of high-grade steel castings. This will be the first electric-steel casting plant on the Pacific Coast.

Melbourne Electrification Contract Secured by General Electric Company.

Attention was called in the issue of December 14, 1912, to the report which had been made by C. H. Merz, of the firm of Merz & McLellan, consulting engineers of London, on the proposition to electrify the suburban lines of the steam railroads at Melbourne, Australia. This report favored the use of direct current at 1,500 volts, and it has been adopted by the Government.

The electrification of these railroads is of exceptional interest because it will be one of the largest projects of its kind in the world, involving heavy rolling-stock equipment with overhead collectors. The magnitude of the undertaking from the standpoint of equipment and service may be compared with that on the third-rail electrified section of the New York Central Railroad out of New York City, and ranks with the Oakland, Alameda and Berkeley electrification of the Southern Pacific Railroad at San Francisco.

After an exhaustive study and consideration of the relative merits of the several propositions, Mr. Merz approved in his report the recommendations of the General Electric Company as to choice of system and economical features of operation, and the Victorian Government awarded this Company the contract for the rolling-stock apparatus equipment, comprising 400 motor-car equipments, consisting of four motors each; 800 control equipments, 400 of which are for trailer cars, and 400 air-compressor equipments. This is the largest single order ever placed for electric railway apparatus.

The mileage of the suburban lines included in the scheme is made up of 150 route-miles, or 289 track-miles of running roads, and 34 miles of sidings. Power will be supplied from a central station at Yarraville, a suburb of Melbourne, in the form of three-phase alternating current at 25 cycles per second, and will be transmitted at 20,000 volts to 12 substations at various points on the system, where it will be converted into the operating direct current of 1,500 volts. The high-tension tranmission is by underground cables from the power house to the important substations in the central area, and by overhead wires erected on the same structures which carry the railway-track conductors, to the outlying substations. Overhead conductors will be used throughout the system for supplying current to the trains, which will be equipped with roller pantograph collectors. The complete equipment of the railways involves the expenditure of $12,000,000 in round numbers, and Mr. Merz figures the saving of electric operation will amount to about $600,000 in 1915 over the former steam-operated lines.

Normal trains, weighing about 180 tons, will consist of two motor coaches and two trailer coaches. Handling heavy traffic during the rush hours of morning and evening will be provided for by increasing the length of trains, although for this initial service it is the intention to have the maximum train consist of six coaches.

The motors, numbering 1,600 in all, which will be installed in the 400 motor coaches, will be of new design throughout and will embody the most modern developments that the General Electric Company has introduced in railway motor construction. They will have inherent ventilation and be provided with commutating poles. They will be rated at 140 horsepower at 725 volts and will be operated two in series on 1,500 volts.

The method of self-ventilation which will be incorporated in the design of these motors will assure exceptionally effective and uniform cooling. This will be accomplished by a broad-bladed contrifugal fan cast integral with the pinion-end armature core head. Fresh air is drawn into the interior through a screened opening on the upper side of the motor frame at the pinnion end. This is circulated over the armature and field coils, under and through the commutator, through longitudinal holes in the armature core, and thence exhausted to the exterior through openings in the pinion and bearing head.

Scientifically correct in principle, this method of ventilation has been demonstrated through service tests to be the most successful manner of securing evenly distributed cooling; for without complication it circulates effectively a large volume of cool air throughout the motor and keeps all parts at a uniform temperature, eliminating the possibility of hot spots. The service capacity of the motor, due to its ventilation, is rendered much greater than that of an ordinary motor of the same nominal rating. At the same time, the weight per horsepower is greatly reduced without sacrificing mechanical strength, durability or electrical efficiency.

The service on the lines calls for both local and express schedules. The motors will therefore be arranged for tap field control, which will allow a free running speed of 52 miles per hour over level track for the suburban cars on express runs. This method of auxiliary control was introduced by the General Electric Company a number of years ago, but due to commutating limitations of earlier motors, it was eventually abandoned. Its successful application to commutating-pole motors is therefore modern.

The principal advantages to be derived from tap field control are increased operating efficiency, continuous saving of power, economy effected through decrease in the weight of the equipment and an increase in the service capacity. The practical effect of tapping the field is to eliminate one resistance step and to secure the desired accelerating effort throughout from start to full speed with a lower current input.

The 800 control equipments for both motor and trailer cars will be the well-known Sprague-General Electric type M relay automatic control. They provide for multiple-unit operation and control of the train from the platform of any motor or trailer car.

It is interesting to note that two of the principal factors that influenced Mr. Merz and the Commissioners to decide in favor of the high-tension direct-current system, rather than the single-phase alternating-current system, were the lower maintenance of the rolling-stock equipment and the saving in energy consumption. They found that the greater number and complexity of the electrical parts carried on the coaches in the case of the single-phase equipments not only causes these equipments to be initially more expensive, but also renders them more costly to maintain; and when routine inspection is taken into account, and also the fact that repairs are necessarily subject to the exigencies of traffic requirements, the maintenance of single-phase equipments would exceed that of direct-current equipments in a slightly higher proportion than that governing their respective first costs.

The direct-current motor selected for these equipments is designed especially to obtain low energy consumption. Based on the several manufacturers' guarantees, Mr. Merz arrives at an economy of 23 per cent in energy consumption in favor of the high-tension direct-current equipment, and estimated that the annual operating cost of the single-phase system would be about $350,000, or nearly 28 per cent, more than for the direct-current system. He also came to the conclusion that the latter system would show an increasing advantage over the single-phase system as the traffic becomes greater year by year.

Electrification of steam roads both here and abroad has emphasized the fact that the conversion to electrical operation is always accompanied by a faster and more frequent train service, and because of greater convenience, comfort and cleanliness, a general improvement in suburban traveling conditions, while the reduction in working cost and the increased earnings of the line combine to produce larger profits.

New French Electric Steel Plant.

It is reported that the well known armament company, Schneider, of Creusot, France, along with the steel company Société des Hautes Fourneaux et Forges d'Allevard, are about to erect a large plant in Pontcharra (Isère Department), for the electrical production of steel. It is stated that the electric furnaces will be among the largest yet built.

Current Electrical News

LIGHTING AND POWER.

(Special Correspondence.)

MAYVILLE, N. D.—Plans are under way for a new municipal electric plant in Mayville. C.

BRIGHTON, IOWA. — Brighton Citizens are agitating a municipal electric light plant. C.

DYSART, IOWA.—A special election has resulted in favor of an electric light plant. C.

SHELLBURG, IOWA.—The Council is considering the proposition of an electric light plant. C.

LOUISVILE, KY.—The Louisville Cotton Mill Company is considering complete motor installation. G.

VINE GROVE, KY.—A $3,500 electric light and power plant is being planned by W. A. Burkhardt, of this city. G.

ARLINGTON, ORE.—At a recent city election the question of a municipal light plant carried by a large majority.

CRESTON, IOWA.—The Creston Mutual Electric Light, Heat & Power Company will increase the capacity of its plant. C.

ANTIGO, WIS.—City officers are considering increasing the lighting service, installing ornamental street lights, etc. C.

TEXHOMA, OKLA.—This city has voted $6,000 in bonds to construct an electric lighting system, to be owned by the town. P.

SHEBOYGAN, WIS.—Steps are being taken by the Business Mens' Association for 1,200 candlepower lights on Eighth Street. C.

GREEN BAY, WIS.—The White Way Club has decided on an ornamental system of lighting on several streets in this city. C.

BLACK CREEK, WIS.—This village is to have electric lights. The Seymour-Shiocton Telephone Company will furnish the power. C.

ST. CLOUD, WIS.—The John Lisowe Company roller mill is considering an electric lighting outfit to furnish lighting throughout the city.

WILLISTON, FLA.—The Williston Manufacturing Company has been granted a franchise for an electric light and power plant in Williston.

DENISON, IOWA.—The city is considering the present electric light franchise. The company has offered to spend $20,000 in the next two years under certain conditions. C.

MORNING SUN, IOWA.—The town is negotiating with the Burlington power Company to distribute electric power in Morning Sun and vicinity. C.

FINDLAY, O.—The Findlay Business Men's Association has recommended to the City Council the erection of a municipal electric distributing plant to cost approximately $70,000.

DETROIT, MICH.—The Eastern Edison Company expects to issue $600,000 in bonds for the purpose of making improvements and adding equipment.

TWO RIVERS, WIS.—The Water and Light Commission has been empowered to spend $3,500 for rebuilding electric light lines and the addition of power lines. C.

WABASHA, MINN.—The Zumbro Power Company has framed its final proposition to the city for furnishing electric current with a power plant and dam at Zumbro Falls.

ST. JOHNS, ORE.—The City Council will receive bids until February 25 for lighting this city, the contract to commence March 1, 1913, and to run not longer than five years.

FULDA, MINN. — Arrangements have been made to convey power for electric lights to Kinbrae and Dundee. Farmers along the route will also have electric light service. C.

SOUTH RIVER, N. J.—The Board of Public Works has decided to install additional machinery and add to the power house. The cost of these improvements is estimated at $25,000.

WINCHESTER, KY.—A committee of members of the City Council has been appointed to complete arrangements for a modern street lighting system to be installed in the city of Winchester. G.

MARINE, ILL.—Local capital is interested in the plan to equip an electric light plant, and the plant probably will be installed with the ice-plant of the Marine Packing Company. Z.

ARTESIA, N. M.—The Pecos Valley Gas & Electric Company is preparing to install additional machinery in its power plant here and to construct extensions of its power transmission system. D.

CONDON, ORE.—It is understood that George Jacobs, promotor, is planning to build an electric plant on the John Day River for the purpose of supplying light to numerous towns in this section.

PROSPECT, O.—Sealed bids will be received by the clerk of the village until March 3 for furnishing electricity for light, heat and power to said village, in accordance with plans and specifications.

RIVERSIDE, CAL.—Bids will be received up to February 19 for a 50-year franchise granting the right to construct and maintain appliances for the transmission of electricity along the public highways of Riverside County.

KANOPOLIS, KAN.—A committee composed of A. E. Sturgis, A. H. Schumacher and W. M. Veitch, has in hand the matter of obtaining information as to the best kind of electric light service and distributing plant will be best for Kanopolis.

MINOT, N. D.—A municipal electric lighting plant is being urged by business men and a committee has been appointed from the Commercial Club to confer jointly with the Consumers Power Company and the City Commissioners. C.

EAST ST. LOUIS, ILL.—The Illinois Power Company has been incorporated with a capital stock of $100,000 for the purpose of manufacturing and selling gas and electricity. The incorporators are Julian Laughlin, Phil Rohan and Herbert Charters.

ST. JOHNS, ARIZ.—The Little Colorado Light & Power Company has been incorporated with a capital stock of $20,000 by E. I. Whiting, Ernest Whiting, Herbert Barry and F. W. Brown. Plans are being prepared for a power plant five miles from here.

LA PRAIRIE, ILL.—The Village Board has asked the Central Illinois Public Service Company a bonus of $500 in exchange for a franchise. The company will build a transmission line from its plant at Augusta to Golden, and proposes to go by way of La Prairie. Z.

SEVIERVILLE, TENN.—D. R. Shearer, Knoxville, Tenn., is in charge of a 65-horsepower installation to be made in the hydroelectric plant of the Sevierville Light & Power Company, of Sevierville, Tenn. The cost of the plant will be $4,000 and the waterpower is already installed. G.

LEXINGTON, KY.—Sargent & Lundy, electrical engineers of Chicago, have plans for the installation of new boilers and a 500-kilowatt turbogenerator in the present building of the Somerset Electric Light & Power Company, of Somerset, Ky., recently purchased by the Kentucky Utilities Company, of Lexington. G.

LOUISVILLE, KY.—The Louisville Lighting Company will extend its line two miles south of Kenwood Hill to the new plant of the Wedgerite Chemical Company; to furnish current for that concern. The Wedgerite Chemical Company, manufacturing high explosives, will buy complete motor equipment in the near future. G.

OAKLAND, CAL.—The Board of Supervisors has granted the application of Attorney Albert C. Agnew to advertise the sale of a franchise and privilege to erect and maintain poles, and to stretch wires or other appliances thereon for the purpose of conducting and transmitting electricity for power, heat and lighting in the county of Sierra, Cal.

JOANNA, PA.—The Geigertown Electric Light & Improvement Company has been organized with a capital stock of $15,000. E. M. Zerr is

president and J. Westley Wolf, secretary. The company will take over the Geigertown mill for a power plant about April 1, and will furnish the territory embraced in the radius of six miles with electric light.

RICHMOND, IND. — Improvements, the cost of which may aggregate $65,000 or $70,000, will be made to the municipal electric light and power plant within the near future. This was decided at a special meeting of the Board of Public Works. It is the plan to double the capacity of the plant and build a large addition to the present buildings and install a new engine and boiler.

KALAMAZOO, MICH.—The city of Kalamazoo has retained Woodmansee, Davidson & Sessions, of Chicago, to build a power plant of about 2,000-kilowatts capacity. Curtis horizontal turbines will be used, and a contract has been awarded to the General Electric Company. Wickes Brothers' boilers and Wheeler condensers will also be used. The city will also install an ornamental street lighting system at an estimated cost of about $24,000.

LAFAYETTE, LA.—Engineer Raymond and the City Electric Light Committee are preparing plans for renovating the light plant and placing it upon a paying and efficient basis. The engineer was instructed to draw up specifications for the installation of new boilers, generators and changing from the direct system to the alternating. The expenditures will be approximately $40,000. As soon as the engineer reports the Committee will advertise for bids.

SALT LAKE CITY, UTAH.—— Thomas W. Cameron, Theodore J. Winkelar, Frank D. Wyant and other St. Louis capitalists have filed application with the State Engineer to appropriate 2,370 second feet, 1,715,000 acre feet of water daily from Green River for power purposes. A dam will back the water up Green River for a distance of about 35 miles and make a reservoir and the water will be used to generate electric power, which will be distributed to various points in Utah, including Salt Lake.

BEARDSTOWN, ILL. — The Beardstown Electric Light & Power Company has sold its plant to the Central Illinois Public Service Company of Mattoon which will expend $100,000 in improving the property. Transmission lines will be built to Rushville, Valley City and the drainage districts along the Illinois River, where the pumping stations will be supplied with power. Lines probably will be built to Frederick and Browning. R. B. Glenn, who was president of the old company, has been retained as superintendent. Z.

PADUCAH, KY.—Kentucky Southwestern Railway, Light & Power Company will issue $1,500,000 bonds for the construction of its first division from Paducah, Ky., southwest to Murray, about 40 miles, work to begin in the spring. H. C. Rhodes, of Paducah, is president, and F. M. Smith, of Paducah, general manager. Plans of the promoters of the company include a system of electric railways, with electric light and power systems, in southwestern Kentucky, aggregating 210 miles. The capitalization of company, outside of bonds, is $1,750,000.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

LANSING, MICH.—The Blue Lake Independent Telephone Company has been incorporated with a capital stock of $990.

THOMPSON FALLS, MONT.—The Mountain State Telephone Company is spending $30,000 on its new system here. C.

MODESTO, CAL. — William Schmidt has been granted permission to maintain a telephone line along the county road.

DES MOINES, IOWA.—The Iowa Telephone Company will invest $822,000 in improvements in Iowa during the present year. C.

PINE RIVER, MINN.—The Pine River Rural Telephone Company has plans under way to build more new lines during the year. C.

CROOKSTON, MINN.—The council has granted a long-distance franchise to the Tri-State Telephone Company, after a delay which has lasted for ten years. C.

WATERTOWN, S. D.—The Dakota Central Telephone Company will build a fireproof exchange building and install automatic telephones next year.

ORTONVILLE, MINN. — The Northern Telephone Company will spend $15,000 to replace the present wiring here and in Big Stone with the cable system. C.

ALTON, ILL.—The City Council contemplates the installation of a flashlight police-signal system, the members having inspected a similar system in St. Louis. Z.

BERNARDSVILLE, N. J.—The New York Telephone Company plans to install an underground conduit system for its lines between Bernardsville and Basking Ridge. A.

CEDAR RAPIDS, IOWA.—The Cedar Rapids & Marion Telephone Company will expend about $33,000 in rebuilding its cable lines and installing conduits for its West Side lines. Z.

FRESNO, CAL.—The Reedley Telephone Company has been incorporated with $25,000 capital stock by E. W. Crosby, D. C. Krehbiel, G. A. Therker, F. A. Baiken and Ira Dick.

KEYPORT, N. J.—In accordance with the suggestions of Fire Chief S. Frank Mason, the Common Council is considering the installation of a new and improved fire-alarm system. A.

CHIPPEWA FALLS, WIS.—The Chippewa County Telephone Company will install automatic telephone systems in Chippewa Falls and Eau Claire at once, at an estimated cost of $15,000. M.

HARMONY, OKLA. — Harmony Telephone Company has been incorporated with a capital of $1,000 by O. C. Bonham, J. N. Green, G. A. New, M. H. Vanbergurg and L. L. Immel, all of Bruno. P.

SEATTLE, WASH.—The City Council was presented with a proposition to submit to a special election to be held March 4 on a bond issue of $2,000,000 to establish a municipal telephone system. C.

SOMERVILLE, N. J.—The Board of Public Utility Commissioners has approved of a franchise to the New York Telephone Company for the construction and operation of additional lines in Somerset County. A.

WELLSVILLE, O.—The Bell Telephone System has authorized the installation of a completely new central office of the most advanced type for Wellsville. Entirely new and up-to-date equipment will be installed.

EMPIRE, CAL.—The Empire Telephone Company has filed articles of incorporation with a capitalization of $14,000. The directors of the company are S. S. Keller, C. F. Rinehart, R. M. Fike, W. H. Shirk and L. E. Miller.

QUINCY, ILL.—Estimates for a fire-alarm system submitted by interested companies vary from $16,500 to $28,000 and the City Council has voted to employ an electrical engineer to make an estimate and to advertise for bids. Z.

VESTAL, N. Y.—Fuller Howwow Telephone Company, Incorporated, has been granted a franchise with a capital stock of $2,000. The incorporators are: Arthur J. Ruland, Binghampton, N. Y.; George M. Ruland and Charles A. Norris, of Vestal.

FRESNO, CAL.—Articles of incorporation have been filed for the Riverdale & Lanare Telephone Company, having a capital stock of $700 to operate a telephone line between Riverdale and Lanare. The directors of the company are Alan Milnes, A. J. Van Cleef and L. A. Nares.

ELECTRIC RAILWAYS.

(Special Correspondence.)

MUSCATINE, IOWA.—Work on the extensions of the Davenport-Muscatine electric railway will be started April 1 and rushed. C.

FT. DODGE, IOWA.—The Ft. Dodge, Des Moines and Southern Interurban Railway Company will spend $100,000 in improvements here. C.

OGDEN, UTAH.—The Ogden Rapid Transit Company has been granted a franchise to operate a railroad over certain portions of the Ogden Canyon road.

MANKATO, MINN.—The Mississippi Valley Electric Company has taken over the local street railway line and improvements and extensions are expected. C.

SEATTLE, WASH.—The Washington Electric Railway Company will immediately issue $2,000,000 in bonds and construct several links in a Portland-Seattle trolley line.

WEEHAWKEN, N. J.—The Board of Public Utility Commissioners has approved of a franchise to the Public Service Corporation for the extension of its electrical railway system in West New York. A.

STEVENS POINT, WIS.—The Chicago & Wisconsin Valley Railroad Company proposes to build extensions from Portage to Stevens Point and Wausau. J. F. Huntoon, Chicago, Ill., is president of the company. C.

SAN FRANCISCO, CAL.—The Big Four Railroad has applied for permission to issue $400,000 of its capital stock, the proceeds to be used for the construction of an electric railway from Tulare to Visalia and from Tulare to Porterville.

WATER GAP, PA.—The Eastern Midland Railroad Company has been chartered at Harrisburg to construct an electric or steam railway line from Matamoras to Delaware Water Gap, approximately 50 miles. The

company has a capitalization of $250,000. A.

YOUNGSTOWN, O.—The Poland Street Railway Company has been incorporated with a capital stock of $1,000 for the purpose of building an interurban railroad. George E. Rose, R. Enson Wick, John T. Harrington, U. C. DeFord and J. W. Blackburn are the incorporators.

TECUMSEH, OKLA. — Provided Tecumseh retains the county seat after the coming election in Pottawatomie County, an extension of the interurban line from Shawnee to Tecumseh will be made to Oklahoma City, according to officials of the Rapid Transit Interurban Company, of this city. Surveys have already been made from Tecumseh to Sulphur. P.

POTTSVILLE, PA.—The stockholders and directors of the Pottsville Union Traction Company voted to borrow $100,000, and it is rumored in financial circles that important extensions will be made in the lines of the company, which now extend from Pottsville to Mauch Chunk, and that the long-projected trolley line from Pottsville to Shenandoah over the summit of Broad Mountain will at last be built. N.

TAYLORSVILLE, KY.—It has been announced by Rowland Cox, chief engineer of the Shelbyville & Frankfort Electric Railway Company, that the line of that company from Taylorsville to Jeffersontown will be constructed in the near future, connecting at Jeffersontown with the Louisville & Interurban Railway Company into Louisville and shortening the distance from Taylorsville to Louisville by 18 miles. G.

LOS ANGELES, CAL.—The Pacific Electric Railway Company announces that arrangements have been completed for the extension of the present Riverside-Arlington line to Corona. The new line will be nine miles in length and will represent the expenditure of about $450,000. Property owners have agreed to arrange for the necessary rights of way and terminal facilities both in Arlington and Corona. Contracts have been let for building the link from San Bernardino to Riverside, by way of Colton.

GARY, IND.—The Goshen, South Bend & Chicago Railroad Company, and the Gary Connecting Railway Company, each heretofore organized under the general railroad law of Indiana, have at a special meeting of the Boards of Directors of the said companies voted to avail themselves of the rights, privileges and powers, and subject themselves to the duties, obligations and liabilities of interurban electric and street railway companies under the law relating thereto and to make such change to interurban electric street railway companies. S.

WAYNESBORO, PA.—The Chambersburg & Shippensburg Railway Company has been organized with a capital stock of $250,000 for the purpose of building a trolley line between Chambersburg and Shippensburg. Thad M. Mahon is president of the company and J. G. Schaff, secretary. The power plant will be erected on the farm at Red Bridge, and will supply electricity for lighting the farm houses along the route and for Greenvillage. It is stated that nearly all the rights of way have been secured. The company was organized in Waynesboro.

PROPOSALS.

ELECTRICAL SUPPLIES.—Sealed proposals will be received by the Navy Department, Bureau of Supplies and Accounts, Washington, **D. C., until** February 25 for furnishing the following electrical supplies:

Article.	Quantity.	Delivery at Navy yard.	Schedule.
Apparatus, welding, electric	1	Boston, Mass.	5160
Blower, foundry, rotary	1	Boston, Mass.	5161
Blowers, ventilating, steel-plate	4	Norfolk, Va.	5162
Fans, steel-plate, exhaust, convertible, and spare parts	Miscellaneous	Brooklyn, N. Y.	5169
Sets, radio	5	Brooklyn, N. Y.	5159
Sets, radio	3	Brooklyn, N. Y.	5159
Wire, cast-steel, crucible, galvanized	38,000 pounds	Boston, Mass.	5174
Drills, portable, electric	11	Brooklyn, N. Y.	5174

ELECTRICAL APPARATUS. — Sealed proposals will be received at the office of the United States Reclamation Service, North Yakima, Wash., until February 21, for furnishing the electrical apparatus for power plant for storage unit, Yakima project, Wash. Particulars may be obtained by addressing the above office.

ELECTRIC ELEVATOR.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until February 27, for the installation, complete, of an electric passenger elevator in the post office at North Plattem, Neb., in accordance with drawing and specification, copies of which may be obtained from the Supervising Architect.

TRANSMISSION-LINE MATERIAL, ETC.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until February 15, for furnishing materials and equipment for the Cristobal-Balboa transmission line, as per Canal Circular 752. Blanks and general information may be obtained from the offices of the assistant purchasing agents in any of the large cities.

ELECTRIC CONDUIT AND WIRING AND INTERIOR LIGHTING FIXTURES.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until March 13, for furnishing electric conduit and wiring and interior lighting fixtures of a three-story building for the post-office at Springfield, Mo. Drawings and specifications may be obtained from the custodian of the site or from the office of the Supervising Architect.

NEW INCORPORATIONS.

PITTSBURGH, PA.—The Conway Electric Company has been incorporated under the laws of Pennsylvania with a capital of $5,000. N.

WILMINGTON, DEL. — Jamison Rail-Bond & Electrical Supply Company has been incorporated with a capital stock of $50,000 by Norman P. Coffin. N.

MILWAUKEE, WIS.—The Wisconsin Railway, Light & Power Company has been incorporated with a capital stock of $1,000 by W. F. Adams, J. B. Blake and J. G. Hardgrove.

FREDERICKSBURG, TEX.—The Fredericksburg Electric Company has been incorporated with a capital stock of $10,000 by Max H. Beckmann, Joe L. Neutwig and Ferdinand Beckmann.

BISHOP, TEX.—The Bishop Water & Electric Company has been organized here with a capital stock of $50,000. The incorporators are F. Z. Bishop, R. R. Hall and H. T. Ellsworth. D.

CHICAGO, ILL.—The Security Lamp Company has been incorporated with a capital stock of $2,500 to manufacture and deal in electrical appliances. The incorporators are Samuel Grossmen. Morris A. Weinberg and Louis Grollman. Z.

PROVO, UTAH.—The Benjamin Electric Light & Telephone Company has filed articles of incorporation with a capital stock of $5,000. George A. Hone is president and Elijah E. Hawkins, secretary-treasurer of the new company.

CHICAGO, ILL.—The S. M. Manufacturing Company has been incorporated with a capital stock of $5,000 to manufacture and deal in electrical appliances. The incorporators are Frank M. Fairfield, J. L. Schureman and George M. McFederies. Z.

CHICAGO, ILL.—The Incandescent Light Company has been incorporated with a capital stock of $10,000 to manufacture and deal in lighting appliances and to do general manufacturing. The incorporators are Fred E. Davis, Jay F. Lawrence and H. H. Hardinger. Z.

VIRGINIA, ILL.—The Virginia Plumbing & Heating Company has been incorporated with a capital stock of $5,000 to do a general plumbing, heating, electrical wiring and contracting business. The incorporators are L. A. Petefish, C. M. Hubbard, Henry B. Handschu and Matt Yaple.

PHILADELPHIA, PA.—The following companies have been incorporated each with a capital of $5,000: Lower Chichester Township Electric Company, and Upper Chichester Township Electric Company, Delaware County; The Green Lane Light, Heat & Power Company, Green Lane, Pa.

COLUMBUS, O.—The Non-Kon Products Company has been incorporated with a capital stock of $30,000 and will deal in products of all kinds which are non-conductors of electricity. The incorporators are Edward F. Kellie, N. T. Garrett, Willis Morris, Caleb W. Melluish and Seth L. Pymer.

HUNTINGTON, W. VA.—Tri-State Power & Milling Company has been incorporated with a capital stock of $600,000 to engage in the milling business and the generation of power for light, heat and manufacturing purposes. The incorporators are R. W. Kline, Salem; H. M. Fox, Roanoke; Z. T. Vinson and A. E. Bush, of Huntington.

OAKLAND, CAL.—The Fog Signal Light Company has been incorporated with a capital stock of $100,000. The incorporators are M. J. Laymance, L. E. Boan, of Oakland; R. C. Douglas, of San Francisco. The purpose of the company is manufacturing and marketing of fog-signal light machines to be placed on ships, docks, lighthouses and other marine appurtenances.

FINANCIAL NOTES.

A contract has been signed by the Southern Power Company and the Georgia Railway & Power Company whereby the Southern Power Company will take over from the Georgia company 14,000 horsepower of electrical energy developed at Tallulah Falls, in Georgia. The contract was negotiated in New York last week between representatives of the Georgia company and the Southern Power Company, W. S. Lee and Z. V. Taylor representing the latter company. The 14,000 horsepower developed from the Tallulah Falls plant is what is known as surplus energy and is the margin between the capacity of the plant and the probable market consumption of the developing corporation. The contract signed is what is known as a short-term contract, from the fact that it can be terminated at will after the time designated in the bond. The Southern Power Company will run transmission lines from Easley, S. C., to Tallulah Falls, the site of the northern terminus of the Georgia Railway & Power Company lines. The generating plant of the company is located there. The new line will be about 15 miles long and will pass through Liberty and Central and other points in South Carolina. At Tallulah Falls the Georgia Railway Company's current will be turned into the Southern Power Company's transmission lines, stretching from Easley, and the power thus secured will be transmitted into South Carolina territory. It will thus reinforce the South Carolina stations, just as the Blewett Falls plant of the Yadkin Power Company now reinforces the northern station of the Southern Power Company.

The Milwaukee and West Allis properties of the Allis-Chalmers Company were sold on February 3 by a special Master Commissioner to J. H. McClement, of New York, chairman of the reorganization committee, representing the buyers' committee, for $2,500,000.

At a meeting of the San Pedro Power & Light Company the capital stock was increased to $350,000 by the authorization of $150,000 six-per-cent preferred stock, proceeds of which will be used for construction purposes. The company operates a power and light plant at San Pedro, Honduras.

The Columbia Gas & Electric Company has $81,454 in its sinking fund for the redemption of its first-mortgage five-per-cent bonds and holders have been notified that the company will receive proposals to exhaust this amount until February 27 at a price not to exceed par and interest.

American Telephone & Telegraph stockholders have authorized an issue of $67,000,000 4.5-per-cent, 20-year convertible bonds, which will be convertible into stock after March 1, 1915, at $120. Stockholders may subscribe at par to the new issue to the extent of 20 per cent of their present holdings.

A $10,000,000 mortgage has been filed by the Washington Electric Railway Company to secure a twenty-five-year, six-per-cent bond issue, of which $2,000,000 will be issued for immediate development. The Equitable Trust Company of New York is trustee. The company is constructing several links in a Portland-Seattle trolley line.

The United Light & Railways Company has sold to stockholders $1,000,600 six-per-cent, first-preferred stock at par, with a bonus of 25 per cent in common stock. This issue of stock makes the capitalization of the company now stand at $600,940 first preferred, $3,060,000 second preferred, and $5,537,500 common stock. Proceeds of sale of new stock will be used in construction program for the coming year and for additions to its properties.

Application has been made to the Maryland Public Service Corporation for incorporation of the Hagerstown & Frederick Railway Company, with $3,000,000 capital, $2,000,000 being common stock and $1,000,000 seven-per-cent preferred stock. The new company would take over the properties of the Hagerstown Electric Railway Company, the Frederick Electric Railway Company, the Frederick Gas & Electric Company and the Frederick & Hagerstown Power Company.

The National Properties Company, which recently acquired control of the electric traction lines from Philadelphia to Wilmington, Del., it is stated, has secured control of the Pittsburgh City Light & Power Company and the Water Company of Tonopah, Nev. The Pittsburgh corporation operates under a perpetual franchise in an important part of the city of Pittsburgh and also in Allegheny County. The company, it is stated, has made recent additions to its power plant. The Water Company, of Tonopah, supplies the city of Tonopah with water under a fifty-year franchise, dated 1905. The New York directors are William F. Havemeyer, H. B. Hollins and Briton N. Busch. The Philadelphia directors are John J. Henderson and Alfred H. Newburger. The other directors are H. B. Scott, of Wilmington, Del.; A. C. Robinson, of Pittsburgh; John Gribbel, of Philadelphia, and T. W. Wilson, of Wilmington.

Dividends.

Binghamton Railway Company; a dividend of two per cent, payable February 15 to stock of record February 1.

Consolidated Gas, Electric Light & Power Company; a semi-annual common dividend of 1.5 per cent, and a preferred dividend of three per cent, the former payable April 1 to stock of record March 20, and the latter to stock of record March 31.

Georgia Railway & Power Company; a dividend of $4.70 per share upon its first-preferred stock, this being at the full rate of six per cent since the incorporation of the company last March.

Portland (Ore.) Railway Light & Power Company, the regular quarterly dividend of 1.25 per cent on its capital stock, payable March 1 to stock of record of February 12.

Tennessee Eastern Electric Company; a quarterly preferred dividend of 1.5 per cent, payable March 1 to stock of record February 1.

Pacific Power & Light Company; a quarterly preferred dividend of 1.75 per cent, payable February 1 to stock of record January 23.

Reports of Earnings.

PHILADELPHIA RAPID TRANSIT.

The Philadelphia Rapid Transit Company reports as follows for December and six months ending December 31.

	1912	1911
December gross	$ 2,065,830	$ 1,964,271
December net	844,300	795,798
Surplus after charges	81,660	54,475
Six months gross	11,926,124	11,344,407
Six months net	4,839,349	4,485,920
Surplus after charges	278,428	55,596

ELECTRIC UTILITIES CORPORATION.

The Electrical Utilities Corporation reports earnings as follows for the year ended December 31, 1912:

	1912	1911
Earnings, all sources	$242,382	$219,288
Expenses	6,418	5,893
Net earnings	235,963	213,394
Preferred dividends	75,000	72,728
Common dividends	22,500	.....
surplus for year	138,463	140,665

INTERBOROUGH RAPID TRANSIT.

The Interborough Rapid Transit Company reports as follows for December, 1912, and for six months:

	1912	1911
December gross	$ 2,962,828	$ 2,845,096
Net after taxes	1,597,520	1,503,477
Other income	45,448	36,642
Total income	1,642,968	1,540,119
Surplus after charges	719,914	601,075
Six months gross	15,737,169	14,850,920
Net after taxes	8,139,354	7,481,170
Other income	206,044	192,796
Total income	8,345,399	7,673,967
Surplus after charges	2,826,972	2,197,898

COLUMBUS RAILWAY.

The report of the Columbus (Ohio) Railway & Light Company for the year ending December 31, 1912, shows net earnings of $1,347,837, an increase of $26,405 over the previous year. A summary of the income account compares as follows:

	1912	Increase
Gross earnings	$2,944,052	$119,563
Net earnings	1,347,837	26,405
Surplus	75,014	*3,406

*Decrease.

Plans for reorganization of the company are now in the hands of an arbitration committee, composed of ten men selected from the boards of the operating and subsidiary corporations, for final consideration.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	Feb. 3.	Jan. 27.
American Tel. & Tel. (New York)	133	133
Commonwealth Edison (Chicago)	142½	141½
Edison Electric Illuminating (Boston)	280	281
Electric Company of America (Philadelphia)	12	12
Electric Storage Battery common (Philadelphia)	53¾	53½
Electric Storage Battery preferred (Philadelphia)	53¾	53½
General Electric (New York)	142⅛	141½
Kings County Electric (New York)	129	129
Manhattan Transit (New York)	1⅛	1
Massachusetts Electric common (Boston)	18	17
Massachusetts Electric preferred stamped (Boston)	77	75½
National Carbon common (Chicago)	115	115
National Carbon preferred (Chicago)	115¼	117½
New England Telephone (Boston)	157	157
Philadelphia Electric (Philadelphia)	21¼	23½
Postal Telegraph and Cables common (New York)	81	81
Postal Telegraph and Cables preferred (New York)	66½	67
Western Union (New York)	71½	72
Westinghouse common (New York)	72¾	72¾
Westinghouse preferred (New York)	116	118

PERSONAL MENTION.

SETON PORTER has been admitted as a member of the firm of Sanderson & Porter, New York.

RICHARD S. BUCH has retired from the firm of Sanderson & Porter, New York, to become chief engineer of the Dominion Bridge Company, Canada.

S. C. LIVERGOOD has resigned his position as chief engineer for the Central Illinois Public Service Company, at Taylorville, Ill., and will engage in the electrical contracting business.

E. S. LINCOLN, consulting engineer, has moved into his new laboratory at 129 Bacon Street, Waltham, Mass., and has changed the name of his organization to E. S. Lincoln, Incorporated.

R. W. WOOD, professor of experimental physics, Johns Hopkins University, Baltimore, Md., addressed the New York Electrical Society on Thursday evening, January 30, on "Photography by Invisible Light."

J. E. ALDRED, president of the Consolidated Gas, Electric Light & Power Company of Baltimore, Md., is starting upon a trip to Europe in order to find a market for the securities of the company abroad.

JOHN H. TRUMBULL, president of the Trumbull Electric Company, Plainville, Conn., has been elected a director of the Hartford Auto Parts Company. Mr. Trumbull takes the place on the board of the late Thomas H. Brady, of New Britain, Conn.

SIGMUND BERGMANN, founder of the Bergmann Elektricitäts Werke, Berlin, Germany, which was recently consolidated with the Siemens-Schuckert Werke, is now on a visit to the United States. A biographical sketch of Mr. Bergmann appeared in the issue of December 21, 1912.

H. M. HOBART, of the consulting engineering department of the General Electric Company, addressed the Schenectady Section of the American Institute of Electrical Engineers on Tuesday evening, February 4. The subject of his address was "Insulation."

C. C. DODGE, president of the Lagrange Light & Power Company, Lagrange, Ky., is at the head of a movement which has been instituted to secure better freight rates from Louisville and other near-by shipping points to Lagrange from the Louisville & Nashville Railroad Company and other roads entering that territory.

J. A. NICHOLSON, Illinois representative of the General Electric Company, was married last week to Miss A. V. Wilkinson, of Decatur, Ill. Mr. and Mrs. Nicholson have gone to housekeeping in Peoria, Ill., and will make their home there. "Nick," as he is well known, has been with the General Electric Company for a number of years and all his friends will wish him well.

THOMAS M. ROBERTS, who recently resigned his position as professor of electrical engineering at Delaware College, has been appointed chief electrical engineer of the Edison Storage Battery Company, Orange, N. J. Prior to his connection with college work the past year Mr. Roberts was for ten years engineer with the General Electric Company, at the Boston district office.

WALTER E. HOLLAND has resigned his position of chief electrical engineer of the Edison Storage Battery Company to take a position as research engineer with the Anderson Electric Car Company, Detroit, Mich. Mr. Holland has been affiliated with the various Edison interests for upwards of ten years and was closely associated with Thomas A. Edison in the pioneer development work on the alkaline storage battery.

E. J. KULAS, for many years one of the most active and enterprising of the younger men in the incandescent-lamp field, has been appointed general sales manager of the Peerless Motor Car Company. Mr. Kulas, while a very young man, was made secretary and general manager of the Brilliant Electric Lamp Company, with headquarters at Cleveland, O. In the summer of 1908, Mr. Kulas was made president and general manager of the Tungstolier Company with headquarters at Conneaut, O., and in connection with this enterprise he traveled extensively, establishing agencies in every part of the country, and made several trips to Europe, the result of

E. J. Kulas.

which was the development of a unique line of electric lighting fixtures which have to a degree revolutionized the handling of material of this kind. In the spring of 1910, Mr. Kulas became president of the Central Station Development Company. There had been growing up in the electrical industry a desire upon the part of enterprising managers of electric lighting and power companies to create an increased demand upon the part of general consumers for the utilization of current-consuming devices of every description. In harmony with this idea the Central Station Development Company was organized, and its plan was to develop advertising propaganda in bulk and project this to the proprietors and managers of electric light and power companies so that they might, at a low cost, take advantage of the syndicated effort of carefully trained and selected men who would prepare advertising matter of every description for the immediate needs of the electric light and power companies in every part of the country. Under Mr. Kulas's direction an elaborate system of correspondence and information departments was organized and this brought to the electric lighting and power industry a very material impetus in accelerating the demands for energy and the utilization of electric lighting and power devices. During the organization and building up of the Central Station Development Company, Mr. Kulas maintained his activities in connection with the Tungstolier Company and developed the former organization to a degree of success meeting entirely all the expectations of those who were chiefly interested in its advancement. Mr. Kulas resigned from the management of the Tungstolier Company at the end of 1912 to become general sales manager of the Peerless Motor Car Company, with headquarters at Cleveland, O., January 1, of this year.

MARSHALL L. Barnes, of Troy, N. Y., one of the best known and most highly esteemed men of the electrical industry, past-president of the National Electrical Contractors' Association, led a rousing meeting on the evening of January 20, under the auspices of the Chamber of Commerce, of which he is the president. In a stirring address Mr. Barnes pointed out the civic activities which the city of Troy would engage in developing the resources of the Trojans and making Troy one of the leading social and industrial centers of the Empire State.

THOMAS CHANDLER, superintendent of the Edison Sault Electric Company, Sault Ste. Marie, Mich., has been granted a three months' leave of absence by the board of directors. Mr. Chandler has had some years of very strenuous and exacting work, and the board thought a vacation was needed. Mr. Chandler will spend the time in recreation and travel, spending most of the time on the Pacific Coast and possibly take in Honolulu. C. M. Wardwell, for many years with the Eastern Michigan Edison Company, is acting superintendent during Mr. Chandler's absence.

HOWARD M. TURNER, resident engineer of the Turners Falls Company, who is in charge of construction work at that place, was tendered a complimentary dinner at the Mansion House, Greenfield, Mass., in honor of his coming marriage to Miss Helen C. Eustis, of Cambridge, Mass. The hosts were officials of the Turners Falls Company and the Greenfield Electric Light & Power Company. The diners included some of Mr. Turner's associate engineers. William B. Durant presided at the after-dinner speaking, and complimentary remarks were made by Philip Cabot, of Boston, president of the Turners Falls Company; Fred C. Abercrombie and a number of other guests.

JAMES BENNETT, who has resigned his position as chief electrical inspector of the Canadian Fire Underwriters' Association, to become manager of the Fire Protection Company of Canada, was presented with a clock, two cut-glass bottles and a purse of gold by the members of the Electrical Association of the Province of Quebec at its banquet at Montreal on the evening of January 16. Electrical contractors, not members of the association, also presented Mr. Bennett with a token of their esteem. Mr. Bennett has been very active in inspection work, and at the annual meeting of the Western Association of Electrical Inspectors, held at St. Louis, last week, was elected president of the association.

NEW PUBLICATIONS.

MUNICIPAL ELECTRICIANS.—The seventeenth annual report of the International Association of Municipal Electricians has come from the press. It contains the proceedings of the convention held at Peoria, Ill., in August, 1912. The volume is neatly bound in cloth.

LIGHTING JOURNAL.—Vol. I, No. 1, of the *Lighting Journal*, dated January, 1913, has come to hand. It contains 32 reading pages of standard size and includes a number of interesting articles and some live editorial discussion. Future issues are promised for the 20th of each month. The editor is Norman Macbeth, and the publication office is at 50 Church Street, New York City. Subscription, $1.00 a year.

NEW GAS JOURNAL.—Gas Publications, Incorporated, Denckla Building, Philadelphia, Pa., has begun the publication of the *American Gas World* a monthly journal devoted to the gas industry. The first issue is dated Jannary, 1913. Its purpose is to incite the members of the gas fraternity to renewed efforts and furnish tools of combat to attain supremacy for that industry. It contains a directory of men active in the industry.

INVESTIGATION OF UNITED STATES PATENT OFFICE.—The report of the investigation of the United States Patent Office, made by the President's Commission on Economy and Efficiency, as transmitted to the Senate and House of Representatives by President Taft, December 9, 1912, has been published in book form. This makes up a volume of 624 pages and contains a study of the patent system in this and foreign countries, the needs of the United States Patent Office, the administration, the methods of examining applications, interference procedure, classification division, the scientific library and the research room, the personnel of the Patent Office, building accommodations and office equipment, publications, term of patent and delays, fees, revenues and expenditures, views of patent attorneys and a digest of subjects not reported on. The appendices contain an elaborate discussion and analysis of the patent laws of the leading nations, a bibliography of the United States Patent Office, and the classification of patents and printed publications. This is one of the most interesting and instructive volumes that has been prepared on this subject, and is indeed a credit to President Taft and his Commission on Economy and Efficiency.

PROPER LAMP VOLTAGES.—The Engineering Department of the National Electric Lamp Association, Cleveland, O., has issued Bulletin 102 in its series of engineering research. This is a discussion of the selection of incandescent lamps for use on circuits having a fluctuating voltage. The bulletin explains in a simple manner the considerations which should govern in selecting a lamp under this condition, and a mathematical demonstration of the relations involved is added. This bulletin should be read by every central-station manager before deciding upon the rating of lamps which he intends to purchase for use on his circuits.

BIG CREEK DEVELOPMENT.—Stone & Webster Construction Company has issued a well illustrated booklet describing the initial development on Big Creek in the Sierra Nevada, in Fresno County, Cal., for the Pacific Light & Power Corporation. The initial installation will be for 50,000 kilowatts, with transmission lines capable of carrying 100,000 kilowatts at 150,000 volts. Two transmission lines of aluminum conductors, 240 miles long, will be constructed to Los Angeles. Two power houses will be constructed using the water in series, with an approximate head of 2,000 feet each time.

DATES AHEAD.

Thirteenth Annual National Automobile Show. Commercial Section. Chicago, Ill., February 10-15.

Electrical Supply Jobbers' Association. Quarterly meeting, Buffalo, N. Y., February 11-13.

Wisconsin State Telephone Association. Annual convention, Madison, Wis., February 12-13.

National Independent Telephone Association. Annual convention, Chicago, Ill., February 18-20.

Automobile Show, Baltimore, Md., February 18-22.

Iowa Engineering Society, Sioux City, Iowa, February 19-21.

American Institute of Electrical Engineers. Midwinter convention, New York, N. Y., February 26-28.

Central Electric Railway Association. Annual meeting, New Washington Hotel, Indianapolis, Ind., February 27-28.

Boston Automobile Show, Mechanics' Building, Boston, Mass., March 8-22.

Minnesota Electrical Association. Annual convention, St. Paul, Minn., March 11-13.

American Electrochemical Society. Spring meeting, Hotel Traymore, Atlantic City, N. J., April 3-5.

Mississippi Electric Association. Annual convention, Natchez, Miss., April 21-23.

Iowa Electrical Association. Annual convention, Waterloo, Ia., April 23-24.

Association of Railway Telegraph Superintendents. Annual meeting, St. Louis, Mo., May 20.

National District Heating Association. Fifth annual convention, Indianapolis, Ind., May 27-29.

National Electric Light Association. Annual convention, Chicago, Ill., June 2-5.

National Electrical Contractors' Association. Annual meeting, Chattanooga, Tenn., July 16.

With the Electrical Manufacturers

Harley D. Carpenter, manufacturer's agent, Meadville, Pa., has moved his offices and storerooms from 190 and 192 Mead Avenue to more commodious quarters in the new Bates Block.

Rome Wire Company, Rome, N. Y., well-known makers of all kinds of electric wires, has issued a neat pictorial calendar card for February. The picture is a romantic one of a young couple wandering in the country on snowshoes.

Thomas Yearsley & Company, Philadelphia, Pa., manufacturer of electrical machinery, recently suffered a loss of about $10,000 through a fire which occurred in its factory at 211 North Third Street. The damage was confined mainly to the armature room.

The Crawford Cedar Company, Menominee, Mich., has established connections with one of the largest western pole producers for the handling of western poles in connection with the white cedar poles which this company has been handling for a great many years.

Dubilier Electric Company, 176 North Fourth Street, Brooklyn, N. Y., has issued some leaflets briefly describing its resistance units and non-luminous electric radiators. A very durable resistance wire is used, and the entire unit is light, compact and low in cost.

James G. Biddle, 1211 Arch Street, Philadelphia, Pa., has sent out circulars illustrating and describing the Luxometer, for which he is the sole agent in the United States. This instrument is a compact and light-weight portable photometer for measuring candlepower, illumination, surface-brightness, etc.

The Simplex Electric Company, Boston, Mass., has changed its name to **Simplex Wire & Cable Company.** This change gives a better conception of the main line of production that the company has devoted itself to. No changes of management or interest are involved in the change of name.

The W. F. Goltra Tie Company, Cleveland, O., has issued in pamphlet form three booklets entitled, "Some Facts About Treating Railroad Cross Ties." These pamphlets discuss the subject of creosote treatment and point out essentials that must be observed in order to secure the most effective preservative value from such treatment.

The Hess-Bright Manufacturing Company, Philadelphia, Pa., has prepared a handsomely printed and illustrated bulletin on the use of ball bearings in machine tools. It gives a brief

history of the use of ball bearings, explains their function, describes the Hess-Bright type, shows numerous applications thereof to a variety of machinery and summarizes the results obtained by their use.

Harrison Safety Boiler Works, Philadelphia, Pa., is sending out circular letters calling attention to the merits of the Cochrane metering heater. This is a combined open feed-water heater and meter, which is made in several forms and sizes to suit various conditions. In this combined unit the exhaust steam from turbines or engines is used for heating the feed water and at the same time accurate record is kept of all feed water supplied to the boilers.

W. N. Matthews & Brother, St. Louis Mo., have issued some circulars pointing out graphically the value of Matthews' guy anchors and the simplicity of their installation. This in itself is an important feature in insuring that they shall be properly installed. Another circular issued by this company calls attention to the Matthews' lamp changers, which are convenient implements for removing and replacing incandescent lamps that otherwise would be inaccessible.

Joseph Dixon Crucible Company, Jersey City, N. J., has issued a new production catalog of 104 pages, which gives a condensed summary of all its graphite products. Included among these are crucibles, lubricating graphites, graphite greases, silica-graphite paint, graphite brushes and other electrical specialties, and a large variety of the famous Dixon American graphite pencils. The book is well printed and finely illustrated. A copy of this interesting catalog will be sent to those interested in graphite products upon application to the company.

C. W. Hunt Company, New York, N. Y., has issued a new catalog entitled, "Hunt Noiseless Bucket Conveyors." This describes and illustrates the Hunt coal and ashes conveyor which is so extensively used in large power and industrial plants and in coaling stations. The catalog describes in detail the various parts of the equipment and its auxiliaries, shows how the machinery may be run by either an engine or electric motor, and gives a very large number of views in typical installations, both in power plants for utility companies and manufactories and in coaling stations of railroad companies.

Otis Elevator Company, New York, N. Y., in the December issue of its monthly publication, *The Indicator,* devotes a large amount of space to the famous Woolworth Building, the new 750-foot skyscraper in New York City which, aside from the Eiffel Tower, is the loftiest structure in the world. A large number of excellent views of the building (one of them covering two pages) and of views from the building are included. The building contains 29 electric elevators, of which six are designed to operate at a car speed of 700 feet per minute and 20 operate at a speed of 600 feet per minute. A unique signaling and dispatching system is used in connection with the elevator equipment.

The Delta-Star Electric Company, 617 West Jackson Boulevard, Chicago, Ill., has one of the most interesting loose-leaf catalogs available for users of electrical material of every description. The contents of this catalog at present include the description of S. & C. high-tension fuses, Delta-Star high-tension equipment, remote-control station indicators, high-efficiency lighting fixtures, series street-lighting information, safety switches, "Arkless" fuses, inclosed fuse blocks, train connectors. Pittsburgh street series lighting systems and Pittsburgh transformers. H. W. Young, president of the Delta-Star Electric Company, reports that outside construction has kept up at such a rate of activity that the demand upon the factory facilities has been the greatest in the history of the company.

Pure Carbon Company, Wellsville, N. Y., has issued a number of circulars calling attention to the new standard classification of its brushes. These are arranged in eight groups, varying in resistance from 0.0024 to 0.0003 ohms per cubic inch. Seven degrees of abrasiveness are provided for each of these groups. The composition of the brushes is carbon, semi-graphitic, graphitic or very graphitic, this corresponding with the current capacity and inversely with the resistance. The company prides itself particularly upon its Tungsten carbon brushes and has a number of circulars and other literature for distribution calling attention to their merits. The company has recently organized an engineering department for the aid of engineers and others experiencing difficulties with carbon brushes of any type. This department is placed at the service of patrons or prospective patrons and will gladly furnish technical information on brushes at all times.

Allgemeine Elektricitäts Gesellschaft, Berlin, Germany, has issued a number of new publications relating to some of the apparatus it manufactures. One of these describes and illustrates a transformer wagon, which is a portable step-down transformer mounted on a wagon, so as to be readily moved about from place to place and has been particularly designed for use in connection with extensive rural power-transmission systems. Another describes portable direct-current indicating instruments, particularly millivoltmeters with various multipliers to give them a variety of ranges; these have a D'Arsonval movement. Another publication describes high-tension fuses mounted in oil cylinders and suitable for operation on circuits carrying up to 100 amperes and 13,000 volts; the fuse element is readily replaceable. Another publication describes what are called reflector receptacles. These are made of glazed porcelain, with a conical surface, surrounding about one-half of the lamp bulb and acting as a diffuse reflector. They are particularly designed for assembling into letters, emblems or designs in electric signs.

General Electric Company, Schenectady, N. Y., has issued three new and interesting bulletins. Bulletin No. 4850C is entitled "Edison Mazda Lamps for Standard Lighting Service." It contains much descriptive matter on drawn-wire tungsten lamps, recites their advantages and characteristics and gives many tables of data. Characteristic and photometric curves and many views of Mazda lamps and of typical installations illustrate the bulletin. There are also given valuable suggestions on the most advantageous use of the lamps, their use with Holophane reflectors and their use for automobile lighting. Bulletin No. A4073 deals with electrical equipment of bakeries. It discusses the sanitary advantages of such an equipment, its efficiency, economy of space, convenience, cost, maintenance and reliability, and illustrates the various pieces of apparatus used in bakeries, equipped with electric motors. It refers also to electric lighting and to electrically heated ovens for bakers. Bulletin No. A4080 is devoted to the use of electricity in excavation and construction work. This bulletin deals with both the generation of the current and its use through motors. It touches on the advantages to be derived from the use of electric power, and refers briefly to its application to the work in connection with the Panama Canal, Catskill Aqueduct, New York Barge Canal and in generaal building construction. Many illustrations of these projects show the actual installations of electrical machinery in their construction.

Record of Electrical Patents.

Issued by the United States Patent Office, January 28, 1913.

1,051,425. Ignition System. C. T. Mason, Sumter, S. C. A make-and-break igniter for use with explosive engines.

1,051,443. Electrical Conduction System for Communicating Electrical Energy. G. W. Pickard, assignor to Wireless Specialty Apparatus Co., New York, N. Y. A submarine conductor for receiving alternating-current stream lines connects a submarine vessel and a float.

1,051,480. Current Controller. L. Bradley, assignor to Allen-Bradley Co., Milwaukee, Wis. The container for a compressible resistance is adapted to be moved by a lever so as to compress the resistance.

1,051,481. Electric-Current Controller. L. Bradley, assignor to Allen-Bradley Co. A modification of the above.

1,051,505. Electric Fixture. J. Le Moyne, New York, N. Y., assignor of one-half to A. C. Hugill. A pull-chain lamp socket.

1,051,542. Voltmeter Switch. C. H. Bissell, assignor to Crouse-Hinds Co., Syracuse, N. Y. Has a circular set and arc-shaped terminals for the test circuits and voltmeter, a rotary switch arm bridging them.

1,051,543. Direction-Finder for Submarine Signals. L. I. Blake, London, Eng. A submerged telephone transmitter has a rotatable screen.

1,051,553. Electric Clock Mechanism. L. G. C. Bush, Elkhart, Ind. Contains an electromagnetic actuator.

1,051,556. Production of Metallic Bodies by Means of Electrodeposition. S. Consigliere, Genoa, Italy. While the metal is being electrodeposited it is hammered by a series of blows from impinging small round, heavy bodies.

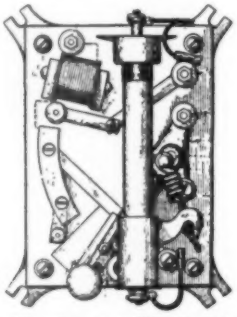
1,051,557. Control of Railway Apparatus. F. B. Corey, assignor to Union Switch & Signal Co. Includes a motor-generator and magnetic clutch controlled by the track circuits and in turn governing the power supply of the train.

1,051,580. Process of Treating Wood for Use in Electric Storage Batteries. B. Heap, assignor to Electric Storage Battery Co., Philadelphia, Pa. Wood separators are soaked in an alcoholic solution, then washed and dried.

1,051,588. Electrically Controlled Lock. W. H. Hollar and H. F. Ballou, Philadelphia, Pa.; said Ballou assignor to said Hollar. Solenoid control for a safe or vault lock.

1,051,599. Telegraph Converter. I. Kitsee, Philadelphia, Pa., assignor of one-half to W. J. Latta. A step-down transformer whose primary is connected with a submarine cable and secondary to the receiving circuit.

1,051,637. Battery-Separator. H. Rodman, assignor to Electric Storage Battery Co. Is formed of a mass of fine sand fritted together by means of powdered glass.



1,051,480.—Compressible Resistance Controller.

1,051,638. Secondary-Battery Separator. H. Rodman, assignor to Electric Storage Battery Co. Consists of finely divided glass, molded without a binder, and fritted.

1,051,642. High-Tension Sparking Means for Explosion Engines. J. E. Seeley, assignor to High Frequency Ignition Coil Co., Los Angeles, Cal. Includes a resonator to give high-frequency oscillatory discharges.

1,051,645. Secondary or Storage Battery. E. G. Steinmetz and E. W. Smith, assignors to Electric Storage Battery Co. The active material is disposed in rods surrounded by stacks of insulating washers.

1,051,675. Method and Mechanism for Producing Musical Sounds. G. Breed, assignor to Lyrachord Co., New York, N. Y. Is actuated by an electromagnet to which a regulated pulsating current is supplied.

1,051,691. Photo-Printing Machine. O. C. Courtright and A. D. Mika, Fort Madison, Ia.; said Mika assignor to said Courtright. A clock-controlled electromagnet releases a latch.

1,051,700. Photographic - Printing Stand. N. De Clark, Jersey City, N. J. The lamp circuit is closed for a predetermined time.

1,051,707. Lock. N. Dorfman, Chicago, Ill. Has an electric alarm associated with it.

1,051,743. Electrically Heated Reaction Chamber. J. MacKaye, assignor to Stone & Webster, Boston, Mass. Is heated through a series of carbon rods in the chamber.

1,051,744. Spark Gap for Impulse Excitation. A. Meissner, assignor to Gesellschaft für Drahtlose Telegraphie M. B. H., Berlin, Germany. Has two parallel electrode plates each having concentric tapering ribs.

1,051,749. Electric-Lamp Switch. N. C. Nispel, York, Pa., assignor of one-half to J. Williams. A resistance-controlling switch moves longitudinally over the series-resistance-section contacts.

1,051,758. Magnetic Separator. J. C. Preslar, San Antonio, Tex. Surrounding an electromagnet is a shell over which a scraping brush moves.

1,051,765. Program Clock. J. E. Rodkey and E. C. Farrar, Axtell, Kans.; said Rodkey assignor to R. K. Farrar. Controls a set of electric alarms.

1,051,782. Flywheel Compensating System. L. Thallmayer, assignor to Aktiengesellschaft Brown, Boveri & Cie., Baden, Switzerland. A motor-generator set with auxiliary compensating dynamo-electric machine and flywheel.

1,051,788. Placard Apparatus. J. Wagner, Baltimore, Md. Is operated by an electric motor and has picture-lighting lamps.

1,051,810. Apparatus for the Electrical Treatment of Gases or Vapors. W. T. Hoofnagle, Glen Ridge, N. J. An electric current is passed through successive charges of gas in a vacuum chamber.

1,051,812. Electric Railway Switch. D. W. Johnson, Saginaw West Side, Mich. A motor-operated track switch.

1,051,816. Electric Secondary Battery. W. Morrison, assignor to Universal Electric Storage Battery Co., Chicago, Ill. The plates are made of recessed sections with porous wood retainers between them.

1,051,821. Dynamo-Electric Machine. W. H. Powell, assignor to Allis-Chalmers Co. and Bullock Electric Manufacturing Co. Has commutating windings supported between the main poles.

1,051,840. Method of Making Steel. H. D. Hibbard, Plainfield, N. J. The charge is first heated by fuel and then by electricity.

Patents that Have Expired.

Following is a list of electrical patents (issued by the United States Patent Office) that expired February 4, 1913.

553,831. Secondary Battery. A. E. W. Boucher, Prilly, Switzerland.

553,838. Successive Non-Interference Signal Box. F. W. Cole, Newton, Mass.

553,839. Non-Interference Signal Box. F. W. Cole.

553,840. Successive Non-Interference Signal Box. F. W. Cole.

553,843. Telephone. S. A. Dinsmore. Chicago, Ill.

553,844. Insulating Joint. W. O. Duntley, St. Louis, Mo.

553,847. Electric Transformer. W. K. Freeman, Fort Wayne, Ind.

553,857. Electric Light Switch. H. W. Lawrence, Denver, Col.

553,858. Spring Supporting-Ear for Trolley Wires. C. A. Lieb, New York, N. Y.

553,873. Non-Interference Signal Apparatus. J. J. Ruddick, Richmond, Ind.

553,890. Electric Program Clock. H. T. R. Zeidler, Berlin, Germany.

553,900. Electrical Whistle-Controlling Device. A. E. Colgate, New York, N. Y.

553,901. Automatic Current Regulator. S. C. C. Currie, New York, N. Y.

553,911. Regulating Socket for Incandescent Lamps. A. B. Hendricks, St. Mary's, Ill.

553,919. Electric Arc Lighting. G. R. Lean, Cleveland, O.

553,920. Electric Arc Lighting System. G. R. Lean.

553,921. Electric Arc Lighting. G. R. Lean.

553,923. Apparatus for Electric Welding. H. Lemp, Lynn, Mass.

553,927. Electric Trolley. N. Muslar, West Boylston, Mass.

553,952. Electric Railway. A. Casazza, Hoboken, N. J.

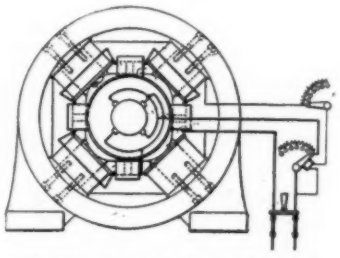
553,957. Telegraphy. P. B. Delany, South Orange, N. J.

553,960. Electrical Igniting Device. W. Kaiser, Vienna, Austria-Hungary.

553,964. Registering Apparatus for Telephones. F. Quatram, Pankow, Germany.

553,965. Electrician's Screw Driver. J. Reece, Pulaski, N. Y.

553,979 and 553,980. Electric Railway. F. C. Esmond, Brooklyn, N. Y.



1,051,821.—Commutating Windings.

553,981. Circuit-Controlling Device for Electric Railway Systems. F. C. Esmond, Brooklyn, N. Y.

554,043. Electric Battery. D. S. Williams and H. M. Hamrick, Philadelphia, Pa.

554,063. Commutator for Magneto-Electric Machines. J. C. Henry, Westfield, N. J.

554,074. Electrical Circuit Closer. L. B. Miller, Elizabeth, N. J.

554,102. Underground System for Electric Railways. W. P. Allen, Chicago, Ill.

554,103. Electric Conductor and Contact Device Therefor. W. P. Allen, Chicago, Ill.

554,104. Underground System for Electric Railways. W. P. Allen, Chicago, Ill.

554,112. Telegraph Key. W. Deats, Amawalk, N. Y.

554,124. Electric Battery. C. J. Hirlimann, Fort Lee, N. J.

554,125. Telephone System. W. A. Houth, Parker, S. D.

554,130. Fuse Holder and Lightning Arrester. H. A. Lewis, Norristown, Pa.

554,138. Mechanical and Electrical Development and Storage of Wind Power. W. L. Negbaur, Brookline, and J. J. Feely, Walpole, Mass.

554,141. Telephony. C. A. Randall, London, Eng.

554,221. Electric Snap Switch. G. W. Hart, Hartford, Conn.